THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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MUNICIPAL TRADING.

THE speeches delivered by Lord Avebury and others at the annual meeting of the Industrial Freedom League, have been reprinted in pamphlet form, and published at the price of sixpence, so that the well-known views of the League regarding the direct and indirect evils of Municipal Trading may be available for general perusal. We are glad to note that the familiar references to sterilised milk are absent, and that when Municipalities are referred to as "undertakers," it is in the Parliamentary and not the popular sense. There is, in fact, a general seriousness about the speeches which is as it should be. Lord Avebury dwelt upon the growth of local indebtedness, from two hundred and sixty-five millions sterling in 1893-4 to four hundred and seven millions sterling in 1901-2. He stated that in more than sixty towns in the United Kingdom the municipal electric light undertakings showed losses. The capital expended in respect to those sixty undertakings amounts to over five millions, and the losses on working were over eighty-six thousand pounds. A comparison of the Northern system of London tramways leased to a company with the Southern system worked by the Council shows, for 1903, a surplus of thirty-seven thousand pounds for the former, against a loss of two thousand pounds for the latter. The question of mere money loss is by no means Lord Avebury's main objection to municipal trading. There are other things even more serious. He instances the Edinburgh and Leith Gas Commissioners opening shops for selling stoves and burners, and the Devonport Corporation competing with banks by receiving money on deposit payable at short notice, which was contrary to all sound financial principles. Another important result of municipal trading is the check to individual enterprise, as instanced by the operations of the Durham County Council and of Corporations in Lincolnshire and Yorkshire regarding electric power works. On these and other grounds Lord Avebury justified the existence of the League, and considered that it appealed to the confidence and support of the industrial and commercial world, and of ratepayers generally.

The appeal to the ratepayer in general is the most hopeful sign, though often considered the most hopeless task. The advocates of municipal trading have already made up their minds that the Industrial Freedom League is an arch enemy whose every fact is fiction, and whose only aim is the creation of private monopolies which may batten upon the necessities of the people. Even a man of such commercial and scientific attainments, and so unimpassioned, as Lord Avebury, is "suspect" to any town councillor who spends laborious days in promoting the welfare of some feature of "trading" which he has no doubt is of benefit to his fellow townsmen. All such will ask what matters the increase of indebtedness if the security remains good and the expenditure is reproductive? The London County Councillor, pledged to the

municipal management of tramways, will ask—and perhaps not entirely without reason—whether the disturbance of traffic, due to reconstruction, was as great in the North as in the South during 1903? Members of electric lighting committees will suggest that the undertakings of the 60 towns showing losses may be comparatively new, not yet of an age when profits might be expected. All sorts of sanguine reasons or suggestions will be urged to minimise the importance or to shift the bearings of the facts which Lord Avebury may bring forward in his capacity as President of the League.

Lord Avebury quotes from the proceedings of the Social Democratic Federation with a view to show that the objects of municipal traders and of that association are identical. Whilst it is obvious that every addition to municipal enterprise promotes to some extent the aims of such a body, we think that to assume that social democracy is the prevailing object of municipal traders would be a mistake. Any attempt to limit the work of the municipality to its proper sphere is bound to fail, unless it recognises that the municipal trading sentiment has its foundations in the desire to retain, for the benefit of the community, profits which previously were, or seemed to have been, made by the individual at the expense of the community. Electrical industries are particularly affected by the municipal trading spirit, because their beginnings were co-incident with the expression of that anxiety about "unearned increment," and that desire for "ransom" which was characteristic of Mr. Chamberlain's earlier political manner. The ratepayer may be influenced by idealists, but if he has taken a wrong course, he will be less likely to retrace his steps by the preachings of doctrinaires than by the assimilation of hard facts. We fear there is much ground for Lord Avebury's complaint, that it is very difficult to ascertain with accuracy the financial results of the business undertakings conducted by municipalities in consequence of their complicated accounts and the tendency to charge one undertaking with some of the expenditure on others. A rigid system of account keeping, and a determination to fairly face obstinate facts, are the first essentials towards ascertaining the true bearings of municipal trading. Arguments as to indirect advantages from direct losses are perfectly justifiable. If these arguments are incorporated in the accounts, no consideration can be given to them. If they follow the accounts, their value and importance can be accurately judged. If municipal corporations do not, of their own initiative, or through the action of the ratepayers, adopt the necessary strictness in account keeping, then the aid of Parliament should be invoked.

On the whole, we have more confidence in the eventual satisfactory settlement of this thorny question than is perhaps generally felt in quarters where the evils attending the indefinite extension of municipal activities are fully realised. The financial side is settling itself naturally. The spendthrift does not continue to borrow indefinitely at low rates of interest. The theory that the ratepayers are the best judges of their own interests seems, at times, an incredible theory to hold, but ratepayers do awaken in time. Municipal councillors, perhaps keen traders individually, have had opened out to them opportunities for the exercise of their special talents, which it has seemed like tempting Providence to lose. They are frequently "strong" men with the bump of tenacity largely developed. To hold on to a losing enterprise in which other people's money is locked up, is an application of strength which is by no means unusual. It will undoubtedly take ratepayers a little longer than other people to estimate the value of such "strong" men, but they will discover it in time. Returning to what we have described as the foundation of the Municipal Trading spirit, we think that almost sufficient experience has now been obtained to enable ratepayers to judge whether a community can always embark upon new enterprises with a certainty of obtaining all the benefits and incurring none of the risks. The desire to avoid local monopolies being the sport of private greed is sound and permanent, but the attitude of unreasoning suspicion of private enterprise upon which so much municipal trading has been built, will give way—is giving way—to a recognition of the value of either in its proper sphere.

Application of Mercury Vapour Lamps.

We are pleased to notice that this type of electric lamp is now being manufactured for the market by the Cooper-Hewitt Co., of America, and that it is finding favour in various places in that country. *L'Electricien*, in a recent issue, learns that it is in successful operation in several places, and gives some instances. Ten of the lamps, each consuming 3 amperes at 115 volts, are being employed in the battery station of the Transportation Co. of New York, which supplies current to hundreds of public vehicles. There they have replaced 14 arc lamps with manifest advantage. Not only is the station unusally dark, and a difficult one to light by reason of the black non-reflecting surfaces of the batteries, but the emission of sulphuric acid spray, caused by the gases given off whilst charging the batteries, had the effect of corroding and injuring the regulating apparatus of the arc lamps previously employed, and necessitated their being enclosed in special cases. The new type of lamp is not only free from this objection, but consumes, for an increased amount of light, appreciably less current. Under the present system of illumination it is possible to examine the cells much more easily and minutely than formerly.

In addition to this installation, the Cooper-Hewitt Co.'s lamps have been introduced in a leather factory and other places. At the leather factory, where the area to be lighted is 1,100 m_2, 30 lamps are to be found, each taking 3·3 amperes at 55 volts. The company is now turning out lamps of different types of high illuminating power. Two of these are of 700 C.P. and one of 300 C.P. A recent introduction is a lamp designed for street lighting. It is half the length of the usual type, and is run in series in pairs. Our contemporary does not further describe this lamp, but remarks that the lamps as now made can be run in a horizontal position, instead of inclined or vertical, as were those of earlier construction.

From the registration, on July 27th last, of a company with a capital of £20,000, under the the title of the Bastian Mercury Vapour Lamp, Ltd., it is to be inferred that active steps are being taken to introduce the very ingenious and promising form of lamp devised by Mr. C. O. Bastian. We described this lamp in our issue of April 1st, 1904, and shall welcome its appearance on the market.

Removal of Ice from the Third Rail.

Since the third-rail system was introduced in the more northerly States of America, it has been found both a difficult and expensive matter to remove, and keep removed, the ice and sleet which form so constantly during the hard winters. Not many numbers of the American traction journals are without des-

criptions of some new method of attacking the enemy which holds up a service as effectually as a snowstorm. Most of them are mechanical in their nature, and we believe that satisfactory results are obtained with the best of them, but, from time to time the obvious method of melting the ice by means of an electric current is brought forward in more or less novel guise. Perhaps with suitably low tension currents of high intensity sent into the third rail from a transformer, the desired end could be obtained with *commercial* satisfaction,* but of this we are distinctly doubtful, bearing in mind the large radiating surface and the miles of rail which often would be dealt with, not to mention the other obvious difficulties which beset the man who wants to do everything by turning a switch, and such a scheme as that which its originator expounds in the *Street Railway Review* for July, is probably not worth the consideration of the practical man, and most certainly never would be adopted in a country such as England, where the trouble which it seeks to overcome rarely arises.

Briefly, the system requires a steel wire held by wood strips and wedges under the head of the third rail, but insulated therefrom, one end being connected to the third rail and the other to the track rails. It is recommended that the wire be run in lengths of not more than one mile, while it is estimated that the power per mile required to raise the temperature of the wire to 450° to 500° F. will be 45 KW., and the time of application is said to be about 15 minutes. The author of the system is confident of its success when applied to a real live line, but at present has only the results of a test on 30 ft. of rail on which to base his rosy convictions. We can at least wish him success, in a more extended practice.

Municipal Sanitation of No Consequence.

We publish in the present issue a legal query, in which a correspondent states facts which show the extraordinary attitude of a certain municipal body towards the private supply of electricity for lighting purposes. The story told by our correspondent shows how anxious the local authority is to ensure that the market shall be kept open in case its application to the Board of Trade for leave to supply under the terms of a provisional order shall prove successful. The facts may be very briefly stated. It appears that, in the village of Oulton, in the County of Norfolk, there were a number of persons who desired to have the advantage of electric light in their houses. Our correspondent, an electrical engineer, with a view to meeting the demand, joined forces with a friend for the purpose of finding the capital necessary to provide the requisite plant. After a few years, during which the firm seem to have met with some adversity, they succeeded in establishing a system which provides sufficient energy for 1,800 8-C.P. lamps, and now brings in the modest revenue of £500 a year. From certain correspondence in the local press, to which we shall presently refer, it seems that although the installation is small, it meets the requirements of the district, and gives satisfaction to all concerned. Pausing here, the question may be asked—What objection is there to the demand for electric light being met in this way? Who objects to our correspondents reaping the small harvest which is the reward of their industry and enterprise? A reference to the query addressed to us by our correspondent suggests that his little monopoly is threatened. It seems that a recently-formed body known as the Oulton Urban District Council, has voted £120 towards the expense of applying to the Board of Trade for a provisional order for the supply of electricity in its district. The plain English of this is that whether it obtains or puts any such provisional order into force, it intends to oppose any application for a provisional order which our correspondent may make. Of course the proposal is made in what are thought to be the best interests of the ratepayers, but we find it is impossible to conceive that the rates could be materially benefited by the supply of electricity on so small a scale, especially having regard to the capital outlay which would be necessary to obtain a provisional order, the grant of which would probably be opposed. The sanguine supporters of the scheme hope to obtain the order for £120. It will be interesting to hear what the figure turns out to be. If it appeared that there was any demand for a municipal supply in Oulton, the proposals of the District Council might be less grotesque. Numerous letters, however, have appeared in the local press, to the effect that the present supply is adequate for all purposes.

Having regard to the facts of the case, it is satisfactory to note that our legal correspondent has been able to speak words of consolation to the firm which is now responsible for the supply. There is nothing in any of the Electric Lighting Acts which renders it essential for those who supply electricity to do so under the terms of a provisional order. Further, provided the cables are not laid under or over any highway, the local authority has no power to interfere. Finally, the undertaker renders himself quite secure if he pays attention to the requirements of the Board of Trade as to the use of overhead wires. The fact appears to show that the consumers are in perfect sympathy with our correspondent. He will therefore have but little difficulty in obtaining the necessary wayleaves; and, so far as we can see, he may continue his present supply whether the Council obtains its threatened order or not.

While, therefore, we think that our correspondent has little to fear at present, there appears to be no possible justification for the proposed provisional order, especially when the ratepayers' money ought to be devoted to improving the sanitary conditions of their district, which are said to be bad in the extreme.

Telegraph Poles and Forestry.

Attention has been drawn to the fact that although many thousands of fir telegraph poles are yearly in demand by the General Post Office for the construction of new telegraph lines and for the renewal of old ones, none of these poles are of native growth, but all are obtained from the great timber-growing regions of Northern Europe. Doubtless, under the most favourable circumstances, the supply which the British Isles could furnish would form but a small proportion of the demand, but at the same time there seems but little doubt that the almost complete neglect in this country of the science of forestry is responsible for the whole supply of poles being furnished from abroad. It is pointed out that hitherto the average landowner has neglected silvaculture, except as a means of embellishing his property, or for protecting it from the cold winds, and it is suggested that in many cases systematic attention to the growing of timber may yield profitable results. So long, however, as it is left to private individuals to plant with the idea of making this country a timber-producing locality, probably little will be done; "posterity has done nothing for us, why should we do anything for posterity?" is the argument, and it is a strong, though, doubtless, a selfish one. Timber growing is a very slow process, and no return can for many years be expected upon the outlay. As, however, in the case of our steam coal, the country is likely to wake up to the fact that we have a duty to posterity, and not only must rapid depletion be put a stop to, but a regeneration of all possible sources of material wealth, upon which the very existence of the nation may depend, must be made a factor of our life, and must be made so by the Government of the nation.

The Board of Agriculture, under Lord Onslow, has taken up the question of forestry, and it is likely that the matter will be dealt with in a proper manner. The question is, of course, not one only of telegraph poles, but of timbers of all sorts and kinds, for fir trees of any magnitude cannot be grown except probably within a limited area, and the demand for wooden poles is, in spite of the extension of underground wires, not likely to diminish.

D

* *Vide Street Railway Journal*, p. 1025, December, 1903.

THE USE OF STORAGE BATTERIES IN LONG-DISTANCE RAILWAY WORK.

By W. N. STEWART.

From the limited amount of space allotted to the above subject on the programme of the coming electrical congress to be held at the St. Louis Exhibition, it may reasonably be supposed that the profession as a whole still preserves an attitude of incredulity as to the utility of the secondary battery as applied to the problem of operating heavy trains over long distances. In this attitude, the profession is, no doubt, justified in so far as the batteries of the past, and the methods in which they have been employed are concerned, but it still remains to be proven that the battery of the present—the latest model of Mr. Edison's alkaline type—used in a new manner, may not have a wide field of usefulness before it.

In the past, lead-acid batteries have been used almost exclusively for the operation of single cars on tramway lines, and used without any assistance from an auxiliary line supply or without the benefits to be derived from any of the regenerative systems now coming into use. So used, it is small wonder that failure has invariably resulted, and a like result would probably follow the use of a greatly improved battery if existing methods of operation only should be employed.

In considering the use of batteries where heavy trains are to be employed, the first thing to be noted is the difference in power consumption between single-car operation and the propulsion of trains composed of four or more cars, a difference due to wind friction. As stated by Armstrong, a single car if operated continuously at a speed of 75 m.p.h. will require energy at the rate of 137 watt-hours per ton mile, while a train of four or more cars at the same speed will require only 47 watt-hours, or only about one-third of the energy necessary for the single car. But in all experiments previously made in the operation of tramways by storage batteries, only single cars have been operated, and it is therefore small wonder that failure has resulted. In long-distance work, with heavy trains composed of four or more cars, it is evident that power would be used at the lower rate, thus saving two-thirds of the first cost of batteries and a like amount in extra weight carried for equivalent work. Even if stops are required as often as once in four miles, the weight and cost of batteries would be reduced by one-half; but on most long-distance lines stops are usually made at longer distances than four miles.

But a still further advance in the use of batteries may be made if they are used in connection with a well-designed regenerative system. Such methods of working as applied to busy tramlines have abundantly demonstrated their value, and they are equally useful for battery traction on long-distance lines. But regenerative working on such lines, *without batteries*, would have only a limited utility because of the fact that comparatively few trains are usually operated. Thus, if two trains only are in use on a given section of line, these trains would necessarily be in one of the following positions: both on upward gradients; both on downward gradients; one moving and one standing at a station, or one on an upward gradient and one on a down grade. In the last instance only would regenerative methods be of any utility, for obvious reasons, where a system of supply from the line only is employed; but if each train carries its own batteries which may be used to receive and retain any energy which may be recovered on down grades or in braking, then we have a system by which we may recover power in all cases, as above stated, except only the first, against one which recovers energy in only one instance, the last. How important this is may be realised from the well-known fact that under existing methods about three-fourths of the total power produced is wasted in heating brakes and resistances, a waste which can be almost completely avoided if we have on the train itself a reservoir in which this power can be retained for future use.

Having, then, a system employing a minimum weight of batteries, with consequent reduction in first cost of same, and a method whereby we may fully recover energy now wasted, have we fully solved the problem?

In a past number of this journal the writer discussed a system of working with batteries employed as adjuncts to a system of line transmission, one set of motors—either continuous current or alternating—being used in connection with the line supply, another set of motors of the direct current type being supplied with energy from a battery carried on the train itself. The motors actuated from the line on such a system would be kept in continuous operation, irrespective of the contour of the line, while the continuous current motors would assist the line motors in starting trains and on upward gradients, and be used as generators to return current to the battery on downward gradients and in braking. Thus the total energy necessary in starting a train or on upward gradients would be derived from the line *plus* the battery, while the recovery on down grades would be that obtainable from the momentum of the train *plus* the total energy received by the line motors. In braking, the energy recoverable would be that derived from the momentum of the train only, the battery elements being thrown into various multiple series combinations in order to secure a low counter E.M.F., thus permitting regenerative working almost up to the stopping point, and avoiding the use of power brakes, and wear of brake shoes and car wheels.

Without going into details, some results of calculations recently made in respect to a foreign railway system may be of interest. It is proposed to work the line by a single-phase system, and estimates were made as to the cost of such a system, both with and without the use of batteries.

Single-Phase System only.

Mean load on line, at trains	6,000 kw.
Generation, transmission and transformation losses (40 per cent.)	2,400 „
Total generating capacity, without reserve plant	8,400 „

Single-Phase and Battery System.

Generating plant	2,400 „
Line and generating losses	960 „
Total generating plant, without reserve ...	3,360 „

In addition each train to carry a battery giving 660 kw.-hours, and having a maximum discharge rate of 540 kw., worked on regenerative system.

It will be noticed from the above that the generating plant is enormously reduced in size, and consequently in cost, when a battery system is used, a reduction which also applies to the distributing and transforming system. Also, the loss in the single-phase system only is 2,400 kw. in place of 960 kw. in the mixed system. The regenerative system allowed for is so worked that on any given round trip the train batteries would be fully recharged, including efficiency loss. The net cost of the battery system, including every requisite, comes out at about £500 per mile of single track, less than the cost of the purely single-phase system. In the battery system each train would be self-contained, able to propel itself to a station or its destination in case of accident to generating plant or transmission system; without batteries, the whole line is at the mercy of the elements. The reduced line losses and saving of energy by regenerative working also shows a large reduction in operating expenses. On similar lines, but operating fewer trains, the saving in first cost is very much more than £500 per mile, as fewer batteries are necessary. On suburban lines, such as those about London, this saving rises to over £2,000 per mile, as the saving in third-rail construction alone more than pays for the batteries.

Why is it believed that the Edison battery will do this work?

In the first place, carefully collated statistics from the lines in Italy where lead batteries were used showed that they were operated nearly 30 per cent. cheaper than were similar lines using steam locomotives; but these statistics also showed that the cost of looking after these batteries, *exclusive of the cost of renewal plates*, was practically as great as the total cost of charging current! But these maintenance charges practically do not exist with the Edison battery, as the only attention required is the occasional addition of a little distilled water, and this is quickly done by unskilled labour by means of a special apparatus. Again, recent tests show that Edison batteries *gain* about 12 per cent. in capacity after being used for 5,000

miles on an automobile. In regenerative railway working the depreciation of these batteries will be practically *nil*, because almost all of the work called for from them is done at between 1·5 and 1·2 volts per cell, or on the gas discharge, the active material in the pockets being scarcely affected, while this false or gas E.M.F. is restored at every down grade, and in braking as previously explained. But the most vital improvement in the Edison battery is that its efficiency at high rates of charge and discharge has been enormously increased, so that less regenerative action is necessary.

From these conclusions, it is believed by many that the last word has not yet been spoken, in regard to the subject of this article.

THE HAULAGE OF COAL ON ELECTRIC TRAMWAYS.

On Friday last, September 2nd, the Huddersfield Corporation Tramways Committee made a trial run of a service of wagons for carriage of coal, over its electric tramways. Coal haulage, or, generally speaking, goods haulage, has been receiving attention at Huddersfield for the last three years; indeed, there was an intention to do something of the kind in the old steam traction days, and the idea was embodied in various Huddersfield Acts. Three years ago, when Mr. H. N. Thomas was appointed general manager of the Tramways Department, negotiations were commenced with the railway company with a view to carrying coals to a mill belonging to Messrs. Martin, Sons & Co., Ltd., who were prepared to enter into a contract with the Tramways Committee. This mill is located at Lindley, about four miles distant from the coal sidings.

Horse haulage, which has been the system employed previous to the present step forward, made the conveyance of coal a costly matter, the road presenting some very steep inclines, but there were many difficulties standing in the way of a change, the chief, perhaps, being the lack of power on the part of the Corporation to run lines into the railway companies' coal shoots at Hillhouse.

Six months ago the negotiations with the railway company were brought to a successful issue. The coal sidings, which appear in one of the accompanying photographs, were the only ones at liberty, and the coal wagon to be used were, therefore, specially designed to fit this particular case. It was impossible to have a 3 ft. 6 in. platform, and one of 2 ft. 6 in. had to be resorted to; further, the headroom had to be cut down, as it was impossible to get a greater height than 7 ft. The wagon, which was designed by Mr. H. N. Thomas, was built by Messrs. Milnes, Voss and Co., of Birkenhead. It is mounted upon a Brush "Radial" truck, is equipped with two Westinghouse No. 80 motors of about 45 H.P. each, and also with the Westinghouse-Newell magnetic brake.

On Friday last the first trial of the wagon took place. Several members of the Tramways Committee of the Huddersfield Corporation (including Councillors Moore and Cartwright, the chairman and vice-chairman), the retiring manager (Mr. H. N. Thomas), and other officials, were conveyed in a special car to the railway coal shoots, where the new motor coal wagon was loaded with about 10 tons of coal, and was then run behind the car to the mills of Messrs. Martin, Sons & Co. The wagon ran the uphill journey very smoothly at good speed, and took the curves beautifully. The experiment was a great success, and the regular conveyance of coal to the mill

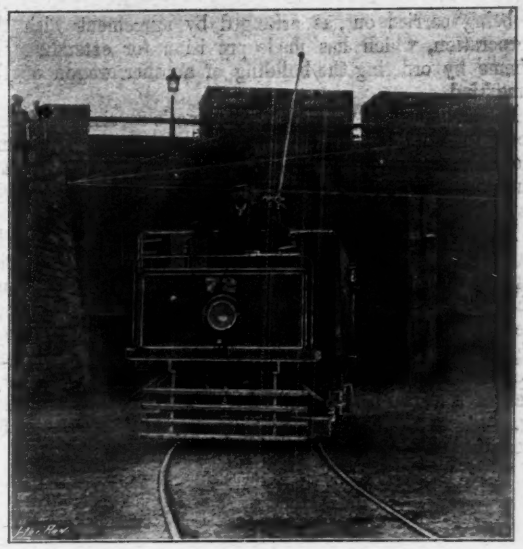


Fig. 2.—Coal-wagon leaving Siding.

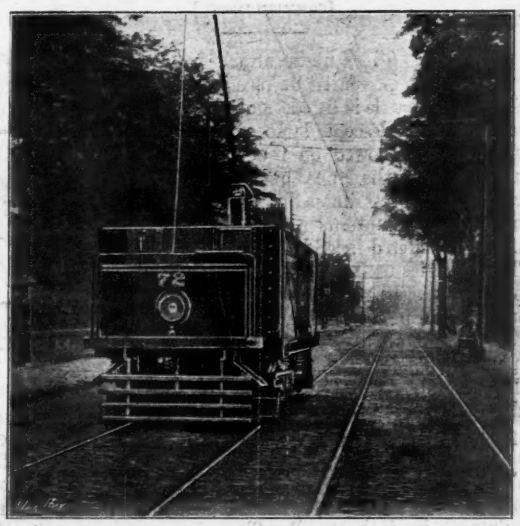


Fig. 3.—Wagon on Line of Route.

Fig. 1.—Coal-wagon at Hillhouse Siding.

is being carried out, as arranged by agreement with the Corporation, which has made provision for extending the scheme by ordering the building of another wagon of the same kind.

It was fitting, in view of Mr. Thomas's special pioneering work in connection with this matter, that the trial runs should be made before that gentleman's departure for Durban, where he is to take up the control of the Municipal Tramways Department straight away.

In regard to the accompanying photographs, it should be stated that they were taken by Mr. J. C. Whiteley, the chief engineering assistant at Huddersfield, who has been responsible for a great deal of the work which has devolved upon the department in connection with this coal-haulage scheme. Fig. 1 shows a tramcar coal wagon in position at Hillhouse coal sidings, Huddersfield, under the shoots; fig. 2 gives a view of a loaded coal wagon leaving the coal sidings; while fig. 3 shows a wagon on the line of route (gradient 1 in 18), showing the class of district traversed.

ELECTRIC NIGHT SIGHTS.

[COMMUNICATED.]

A SHIP engaged in a night attack is shrouded in complete darkness which is secured by closing all the dead-lights with which every scuttle is fitted, and switching off the dynamo from the incandescent lamp circuit. No lights of any description are allowed on the upper deck, and the consequence is that the guns have to be worked in complete darkness, this necessitates the use of "night sights." These consist of tiny lanterns containing very small glow lamps which are rendered incandescent by batteries.

The batteries used for this purpose are of the Leclanché type, the prevailing type of battery in the Navy, but differing from the ordinary fusing battery in having agglomorate blocks instead of loose carbon and manganese dioxide held in place by flannel or "fearnought" bags.

In the night-sight batteries the container is cylindrical, and the carbon is packed in with six agglomerate blocks held in place by means of stout india-rubber bands. The zinc rod is enclosed in a porous pot and the cell is then carefully sealed up with pitch, a hole, provided with a cork, being left for the insertion of sal ammoniac when the battery requires to be "charged." The size of the container is about that of a quart measure, and each battery consists of three cells joined in series.

These batteries are supposed to be capable of giving sufficient light in the two glow lamps to allow of continuous firing for two hours, and a constant electromotive force is maintained by varying the resistance in circuit by means of switches.

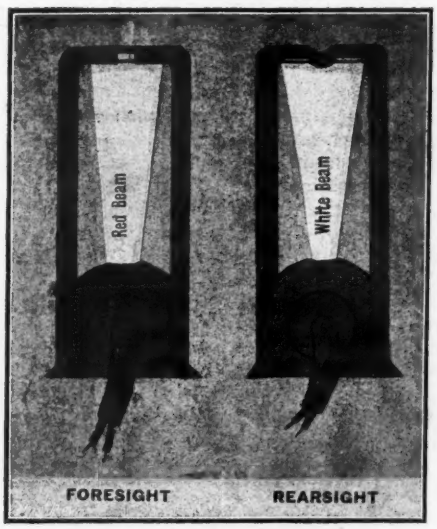
The small glow lamps are mounted in vulcanite holders enclosed in little brass cases or lanterns, formed of short lengths of brass tubing. To obtain a tiny beam of light only, there is a hole drilled in the tubing opposite to the lamp, and in this a little glass window is mounted, the glass in one case being coloured red, and in the other left colourless. This is in order to more readily distinguish between the fore and rear sights.

The lanterns are joined in fork to the battery, and are easily shipped on to the ordinary day sight. Now the form of sight used in daylight is as follows:—The foresight consists of a "pea" or bead mounted on a knife-edge, and is fixed—that is to say, it does not alter its position to allow for deflection or distance; the rearsight, on the other hand, may be screwed laterally along a scale to allow for deflection and windage, and can also be raised or lowered vertically according to the range. It is H-shaped, consisting of two uprights crossed by a thin bar. In order to get a correct alignment the captain of the gun trains until the bar of the rear sight directs the "pea" for elevation, and until the "pea" is exactly sideway between the uprights for direction.

Now very naturally the captain of the gun being used to this method of sighting requires as close a representation of the bar and "pea" for his night sights, as possible, and a very good imitation is obtained by reflecting the light of the rear sight in the form of a bright line, and that of the foresight in the form of a bright spot.

For this purpose a U-shaped piece is fitted on to the lantern immediately above the beam of light, and in the fore sight a tiny mirror of polished metal is let into the centre of the inverted U frame at an angle of 45°, this reflects the light in the form of a small red speck. The rear sight has a slight depression in the centre, on either side of which a strip of polished metal inclined at 45° reflects a line of light broken in the centre where the depression is. The reflection of the fore sight is red, and thus the captain of the gun trains until his red spot is just filling the break formed by the depression, in the line of light that is visible as a broken white band upon his rear sight.

Now, the upper deck being in total darkness, some means of illuminating the sights is required in order to adjust them. Nothing in the nature of an ordinary lantern must be used, because it would give the enemy a clue to the ship's



ELECTRIC NIGHT SIGHTS.

position, and so the night sight itself can be taken off, and its top unscrewed, so that the small glow lamp can be shone upon the markings of the sight while adjusting it. Thus the light performs a double duty.

Theoretically, these sights are excellent, but in practice they are not quite all that could be desired. The instructions are that, while the gun is being loaded, the lights are to be switched off, in order to give the battery a chance to recover, but this is not at all to the taste of the captain of the gun, who wishes to keep his training "on" the whole time. The battery power rapidly falls with the continued use of the lamps, and all the resistance is cut out in order to get a good glow, with the result that night sights become a source of much trouble. The batteries are not really up to the work they are called upon to perform; but, considering their limited size, this can hardly be wondered at. Accumulators have been suggested to take their place and, really, if a small portable and thoroughly efficient form of accumulator that might be charged from the dynamo was introduced, a few trials would probably very soon establish a verdict in its favour. At present accumulators are not very widely known in the navy; they are only used for the electric light installation, and not very generally even for that. There seems to be a great field for the accumulator once a satisfactory type becomes generally known, but it should be portable, and not liable to spill and corrode metallic fittings in its vicinity. It should be easily charged, and should not require to be rebuilt frequently. It should be capable of maintaining its efficiency for a definite period, say three months, during which time it can be depended upon to give, at any moment when required, a standard output.

In the case of night sights, it should be able to light two glow lamps in fork for at least six hours, after which it might be replaced by a duplicate. Were such a battery

introduced, and especially if it possessed some sort of indicator to show how far it had been exhausted, there seems to be little doubt that it would rapidly supersede the present Leclanché battery, both in use for night sights, and for electric fuses.

THE PREVENTION OF ACCIDENTS IN HANDLING ELECTRICAL APPARATUS.

Familiarity with danger often breeds contempt for ordinary measures of precaution; and more accidents in industrial pursuits are due to carelessness or indifference on the part of the artizan than to the inherent danger of his occupation. Obviously, if there were no danger, neither carelessness nor indifference could lead to accident; but, on the other hand, danger may be regarded as a potential force requiring the releasing touch of carelessness, or of the contempt bred of familiarity, to convert it into a kinetic power for destruction.

The recent fatal accidents that have occurred on electric railways, due to contact with the "live" rail, are scarcely cases in point, as these seem due to an absence of adequate protection, rather than to want of care on the part of the victims. On the other hand, accidents such as that which resulted in the death of an employé of the Metropolitan Electric Supply Co. recently, point to an absence of ordinary precautions in dealing with apparatus carrying a dangerous pressure. In this instance, the workman attempted to cut a pipe containing a live main. After a hole had been cut in the pipe, a wedge was driven in, in order to burst the pipe, with the result that the wedge touched the "live" conductor and the man was killed. At first sight it seems strange that the man should have received a dangerous shock, that is, assuming the chisel to have been touching the pipe at the time. The probabilities are, however, that as the pipe burst the chisel went suddenly forward into the cable, whilst, for the instant, it was clear of the pipe itself, and so the workman holding it would form the only path between the earthed pipe and the cable. Rubber gloves are in future to be worn by men engaged in operations of this kind.

The spread of the application of electric power into works, factories, mines, &c., introduces a new element of possible danger to workmen employed therein, and in order to prevent accident it will be necessary to instruct the men, more particularly those who have to handle electrical apparatus, as to where danger lies; how to avoid it, and how to proceed in case of accident.

A pamphlet with these objects in view has been issued to the employés of the electrical department of the Illinois Steel Co., and is reproduced by the *Western Electrician*. In it the dangers peculiar to the duties of electrical workers are classified under four heads—(1) those attributable to shocks due to passage of current through the body; (2) burns or injuries due to contact with the electric arc; (3) flashes, or injuries to the eyes by exposure to arc light; (4) falls caused primarily by shocks or burns.

It is then explained how a shock may be received, and what precautions should be taken. Some of these conditions would not obtain in this country except in the generating stations of power supply companies generating at 20,000 volts three-phase, or in the works of manufacturers of high-tension apparatus. The principal precautions advised may be condensed into the following:—

1. *Shocks.*—Never work on 20,000-volt mains or apparatus until the pressure has been absolutely cut off.

2. On 5,000-volt arc light circuits, only experienced men should work. Before touching a lamp, it should be cut off. (This, in the works referred to, does not isolate the lamp.) The lamp attendant should stand on a dry box or an insulating platform when at work on a lamp. Before taking hold with either hand, he should touch the parts on which he intends to work, with the tips of his fingers, to make sure that he will receive no shock.

3. No work should be done on the "live" 1,100-volt and 2,200-volt circuits without special instructions from the chief electrician. A shock from these circuits is sufficient to cause instant death.

4. An experienced man may handle 440-volt "live" alternating circuits by exercising great care, but it is better to have the power cut off, as the pressure is sufficient to cause severe shock, and even to kill, under certain conditions.

5. Under ordinary conditions, 250-volt direct-current circuits are not likely to cause death by shock, but the same precautions should be observed as in handling higher voltage, not only in order to avoid possible injury from shocks and burns, but to form habits of precaution in handling wires.

6. The shunt field of a motor should only be opened in such a way as to allow of the inductive discharge to take place without causing a shock.

Burns.—Burns may be caused, even when no shock is experienced, by contact with an electric arc. A short circuit is the most usual cause of an unexpected arc. An arc may be caused by a lineman's pliers or other tools connecting the two polarities of a circuit together; by a wire dropping across; by bringing two wires together without knowing they are of opposite polarity, or while thinking they are "dead." Arcs are also caused by opening switches carrying large currents, or closing them on a short circuit.

7. Avoid short circuits. Do nothing without first being sure of the conditions of the line. Take no chances.

Flashes.—Flashes are caused generally by an unexpected arc. The intense light of the arc is very dangerous to the eye, although the injury may not be manifest until several hours after looking at an arc.

8. Never look at an intense light such as an arc, except through dark glasses.

Falls.—The surprise of a sudden shock, even a slight, and in itself harmless, shock, may cause an unconscious contraction of the muscles, resulting in a fall, therefore:

9. Be careful not to receive even a slight shock when working in a position in which a fall would be dangerous.

Care of Injured.—In the event of a shock producing unconsciousness, the remedies to apply are similar to those used to resuscitate the apparently drowned, and every electrical worker should familiarise himself with these methods. [Rules for the resuscitation of persons suffering from electric shock may be had from the Electrical Review Publishing Offices. They are mounted on a stiff board suitable for hanging up in a works.]

The pamphlet from which the above rules have been abstracted concludes with the following list of

"*Precautions to be Observed.*—Avoid working on live electric circuits as much as possible.

"Where the power has been cut off by opening a switch located at some distance from where the work is being done, always place a sign on the switch, saying that men are working on the line.

"When the work is completed, remove the sign. No man, except the man who placed it, should ever remove such a sign.

"Never close a switch, without full knowledge concerning the circuit, and why the switch was opened.

"Never handle electric wires while standing or sitting in a wet place without extra precaution to obtain insulation from ground.

"In handling any circuit known to be alive use only one hand. It is best to keep the other hand behind the back. The most dangerous shocks are those from hand to hand.

"So far as possible, treat all circuits as though they were alive, even though you believe them to be dead.

"Be cautious and alert at all times and under all conditions."

Although the above suggestions have been drawn up for the men engaged in a particular works, they will, no doubt, be of value to others who have to handle electrical machinery or apparatus. The pamphlet from which the substance of the above has been abstracted and classified was originally prepared by Mr. E. B. Clark, assistant general superintendent of the South Chicago Works of the Illinois Steel Co.

We might point out, in reference to the paragraph numbered (2) that isolating switches *can* be used in connection with arc lamps burning in series. These switches may be arranged either to insert an equivalent resistance into the circuit on cutting out the arc, or to merely join the two lamp

leads directly together, after disconnecting them entirely from the lamp. In many cases the switch is automatic, coming into action if the carbons should stick up and the arc go out. Referring to (6), a little further explanation might be given as to how a shunt circuit of a motor can be broken without risk of shock. The simplest and best way is simply to first break the main motor circuit on both poles, when the shunt discharge will take place through the armature. The shunt circuit can then be opened with impunity.

THE BRITISH ASSOCIATION, CAMBRIDGE, 1904.

THE ACTION OF LIGHTNING STROKES ON BUILDINGS.

By Killingworth Hedges, M.I.C.E., Hon. Secretary, Lightning Research Committee.

(Read in Section G.)

In a paper entitled "The Protection of Buildings from Lightning," which was read at the Glasgow meeting of the Association in 1901, the author mentioned the establishment of the Lightning Research Committee, organised jointly by the Royal Institute of British Architects and the Surveyors' Institution, who have since investigated a very large number of occurrences from the reports furnished by their observers. It was decided after the first year to confine the Committee's investigations to buildings which were fitted with conductors; and, following this course, the reports on about 40 protected buildings affected by lightning have been summarised by a sub-committee, and are having the attention of the general committee, who will in due course issue a report.

The principal causes of the failure of the usual style of lightning rod as fitted on the buildings investigated appear to be due to the following:—(1) Insufficient number of conductor and earth connections; (2) the absence of any system of connecting the metallic portions of the buildings to the lightning conductor, especially the interconnection of the finials, rain-water pipes, and gutters. In the author's opinion, the frequent damage by side-flash from the conductors might be lessened by running a horizontal conductor along the ridge, or along the parapets of all the roofs, somewhat after the method which is almost universally adopted in Central Europe.

The lightning strokes may be divided into three classes:—(1) Those where the conductor conveyed a portion of the flash to earth, but the side-flash to other unearthed metallic conductors damaged the building; the practice of running the conductor round the projecting masonry, often taking sharp bends, doubtless facilitated the deviation of the current from its direct path to the earth. (2) In several observations a metallic roof of large area received the flash, consequently became highly charged, and the single conductor failed to convey the whole of the stroke—a portion of which took a circuitous path—for instance, through a speaking-tube and an electric bell wire. (3) A flash struck the building at two points simultaneously, a lightning conductor taking one part of the stroke, but damage was caused by the other portion selecting an unprotected part of the roof.

Earth Connections.—With a few exceptions, these had the defect common to nearly all earth-plates which are simply buried in the ground close to the foundations of a building, and owing to drainage soon became dry, consequently are of very high resistance. Architects, as a rule, object to sufficiently deep holes being made near a structure; consequently the permanently moist ground is not reached. The tubular earth designed by the author does away with this objection, and can be kept moist by leading a small tube to the nearest rain-water pipe.

Interconnection with the Metal Work of a Building.—Although the utility of the external metal was specially put forward in the report of the Lightning Rod Conference in 1882, their recommendation has been apparently disregarded in all the cases under review. The Cavendish Laboratory (No. 64) stroke, which was fortunately unattended with danger owing to the gas in the gas-pipe which formed the path of the current being turned off, would not have taken this circuitous path had the leaden roof been connected to the conductors which ran down the tower only, also to the rain-water gutters and pipes, which should have been interconnected at the bottom and properly earthed. Again, at Bedford (No. 88) last year, St. Paul's Church was seriously damaged by the flash leaving the single conductor on the tower by the water on the roof and passing thence to earth by means of the rain-water pipes. In this case it is interesting to note that the lead pipes were not fused, but their round section was changed into an oval one; the iron water-pipes were broken. This incident and No. 68 (St. Pancras Church, Euston) show clearly that the damage was due not to direct stroke, but by a portion of the flash leaving the main conductor and taking a circuitous path round the unconnected metal work outside and inside the buildings.

Observation No. 2: Kea Church, Truro.—The copper sheathing of the spire, owing to its great capacity, could not discharge through the one excellent conductor to earth, consequently the flash divided, part going by the conductor and part by the alternative path formed by the copper covering of the spire to a rain-water pipe, thence sparking through a parapet wall to lead flashing down another pipe, and then along a very small copper wire used for training plants, to the main conductor. Similar effects were noted in Stoers Lighthouse (No. 54) and Devaar Lighthouse (No. 56), the divided flash in the former leaving the conductor for a telephone wire and in the latter for a speaking-tube. In these observations the conductors may be said to have acted to a certain extent, and if the structures had been entirely unprotected the damage would have been greater, but by proper attention to the necessities of each case, and increasing the number of the conductors, the risk would probably be nil, as there would be a definite path for the lightning to take.

Quite the most interesting case is that at Possingworth House (No. 67), struck in June and again in August, 1902, although the roof fairly bristled with air terminals, every chimney being protected, mostly with its own conductor and earth connection. It is probable that on the second occasion the flash divided, one part selecting a chimney stack, which it damaged, bending the air terminal to an angle of 45°, while the other, neglecting the many many points, fell on an unprotected statue much lower than the chimney and went to earth by the iron frame of a conservatory, showing the unreliability of a number of independent conductors which should have been interconnected by means of a horizontal wire led along the ridge; this would in all probability prevent any serious damage.

Sir Oliver Lodge has shown by an interesting experiment that a column of hot air is often selected by a flash although a lightning rod may be affixed to the side of the chimney. Most of our large stacks have a band of metal to which the air terminals are fitted, and from these two conductors should be led to earth. The method adopted in Germany appears to be simpler, and consists of a heavy iron frame rising to a sufficient height above the stack, and continued at the apex so as to form an aigrette. That lightning may prefer the smoke issuing from a chimney was shown by the stroke at the East London Waterworks, Sunbury, last year, the flash doing some damage to the capping before it arrived at the standpipe inside, which was a perfect earth in that it was in direct connection with the company's mains.

The general conclusions arrived at by the author are that there is very little advantage in placing isolated rods on an ordinary building without it has a high tower. A church, for instance, with a spire should have at least two conductors from top to earth. Even then, if any other part of the structure happens to be in the path of a discharge from a cloud to the ground, the stroke may disregard the protected towers or spire and fall on the building, choosing some lower point. If the suggestion put forward by Sir Oliver Lodge at the Bath meeting in 1888 were more closely followed, and the conductors so arranged that they form a protective network over all the roofs, a flash would in all probability be received by some portion of the system and pass without harm to the ground by one of the numerous earths to which the network would be connected.

The insurance offices appear to disregard the question of adequate protection, and are quite content if the single conductor which has not prevented serious damage, for instance, to a church, is replaced, and, moreover, they take no steps to have the earth connection tested periodically; also the few unconnected lightning rods erected on our national museums, picture galleries, and other public buildings contrast most unfavourably with the more scientific methods adopted on the Continent, more especially in Germany, where in some districts the local authorities have issued rules as to the erection and testing of lightning conductors, to which the various public bodies have to conform, and in some cities householders are subject to penalties if the system is allowed to get out of order.

THE HOPKINSON TEST AS APPLIED TO INDUCTION MOTORS.

By W. E. Sumpner, D.Sc., and R. W. Weekes, M.I.E.E.

(Read in Section G, August 22nd, 1904.)

The late Dr. Hopkinson was, as is well known, the first to suggest a method of testing direct-current dynamos by arranging similar machines in pairs so as to circulate the power, the portion of the power wasted being supplied from some external source. The method and its advantages are well known in regard to direct-current machinery. The principle of the method is, of course, applicable to any form of apparatus capable of transforming energy in a reversible manner. It was applied to the testing of alternating-current transformers by one of the writers some years ago, and it has since been utilised for the testing of alternators. The application to three-phase machinery involves some special points, and the writers, who have lately tested a number of induction motors by this method, have found it so satisfactory that it seems desirable to draw attention to the experimental details involved in the test.

The two similar machines have their stators connected with the mains, while their rotors are belted together. Switches must be used with the stator connections, if the rotors are of the short-circuited type, but are unnecessary if the rotors are supplied with starting resistances. The connections must be such that the belt is driven in the same direction whichever motor is started. The pulleys on the rotors must be of different diameters, since one rotor must run above and the other below the synchronous speed. The ratio of the diameters must be such as to cause the right amount of slip for the load required, assuming the rotors are to remain short-circuited during the test. If the slip of each motor is 3 per cent. at full load, and if 12 per cent. of the load is lost in each machine, the overload of one machine will be approximately 24 per cent., corresponding with a slip of 3¾ per cent.; while the other machine, working as generator, will give out full load and have a negative slip of 3 per cent. The pulley diameters must thus differ by 6¾ per cent., assuming no mechanical slip between the belt and the pulley, or, if 1 per cent. be allowed for this, the pulleys must differ by about

8 per cent. in size. With such pulleys, the machines, when switched on to the mains, will be subjected to a perfectly steady load admirably suitable for a long run on load. But with given pulleys, the load cannot be adjusted or altered unless resistance is put in the rotor circuits. This can easily be arranged by using low-resistance connections between the rotor slip-rings and the short-circuited starter, or, better still, by using, when available, a rotor starter which can stand the passage of the load currents through the rotor circuits. By adjusting the position of the starting switch, the load can then be adjusted to any desired amount, if the rotor pulleys have been chosen sufficiently different in size to fully provide for the slips required. The losses in the rotor resistances are very small, and can in most cases be neglected. They are, however, easily measured, and should be subtracted from the power taken from the mains in order to arrive at the total losses in the two machines and in the belt drive.

Another method of adjusting the load consists in altering the voltage of supply. For given values of the slip, the torque of the machines, and therefore the load, is proportional to the square of the voltage.

The arrangement of instruments and circuits is shown in the diagram. The power, w, taken from the mains, must be measured, and also the power, W, in the circuit between *one* of the machines and the mains. The machine used as motor, of course, takes the greater amount of power, and if W refers to the power given out by the generator, $W + w$ is the power supplied to the motor. Otherwise the difference between these quantities is the power given out by the generator. The load of each machine and the losses in the

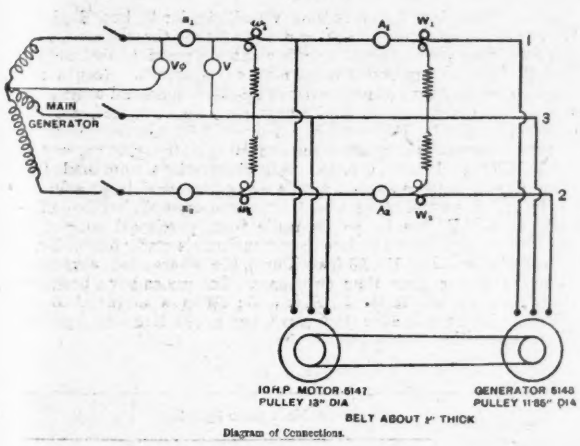


Diagram of Connections.

two are thus determined, and the efficiency can be obtained in the same way as for direct-current machines. In regard to the measurement of power, it will be found sufficiently accurate for all commercial measurements of efficiency to use the single-wattmeter method (which assumes that the load is balanced between the circuits), and treble the reading of a wattmeter with its current coil placed in one circuit, and its volt coil connected between this and the neutral point. It is, of course, more accurate to use the two-wattmeter method as sketched in the diagram. The connections are then less simple, but from the ratio of the two-wattmeter readings the power factor of the circuit can be determined independently of the ordinary method of comparing the watts with the volt-amperes. Care must be taken in reading the wattmeters in the main circuit if the two-wattmeter method is used, since one of these readings will be negative owing to the low power factor of the current taken from the mains. A curious point about the test is that the machine used as generator produces current of about the same power factor as that of the current supplied to the motor, while the current supplied by the main circuit consists of the difference of the power components of the machine currents, together with the sum of the inductive components of these currents. The result is that the power factor of the current from the mains is very low, only about one-third of that of the machine currents. It thus happens that while the power taken from the mains may be less than one-third of that circulating round the machines, the current from the main generator is about equal to and may exceed that passing through the machines, a striking contrast with what happens in the corresponding test of direct-current dynamos.

The slip of each machine can be determined most conveniently and accurately by measuring the frequency of the rotor currents, by suitably shunting any ordinary low-reading direct-current voltmeter to the slip-rings of the rotor. The period of the slow oscillations of the pointer can be measured with greater accuracy than the frequency of the main circuit currents. The ratio of the two frequencies is, of course, the slip of the machine.

A most interesting point in connection with the tests is the possibility of determining the belt losses, and the value of the mechanical slip between the belt and the pulleys. The losses due to the belt drive are caused by (1) extra bearing friction and in bending and driving the belt; (2) heating of the pulleys due to belt slip. The former loss (1) can be measured by reading the wattmeter in the main circuit, firstly, when only one machine is in circuit and driving the other by belt (with its stator excited, but with its rotor open circuited), and, secondly, when both machines are running light with the belt off. The difference of the two readings gives the belt driving losses. The latter loss (2) is determined by the ratio of the circumferential speeds of the two pulleys. This is a quantity difficult to determine with any accuracy in ordinary belt drives. The above test seems specially suitable for determining its amount. The ratio of the rotor speeds is

$$\frac{F + g}{F - m},$$

where F is the frequency of the current from the main generator, m that of the currents in the motor rotor, and g that of the currents in the generator rotor. Now, m and g are quantities which can be very accurately determined, and are each small compared with F, so that, although F cannot be determined with such great accuracy, the form of the above formula shows that the ratio is not appreciably affected by small errors in F. Thus the ratio of the rotor speeds can be very precisely measured. To obtain the ratio of the circumferential speeds of the pulleys, we have merely to multiply the above number by the ratio of the pulley circumferences, a quantity which can be accurately determined. A good experimental means thus exists for finding the actual values for the slip of belts under various conditions.

A number of experimental results obtained in testing various motors by this method have already been published by the authors in the *Electrical Engineer* for June 17th last, and some of them are reproduced in the appendix. Experience with the method shows that it possesses all the advantages associated with the Hopkinson test of direct-current machines. If anything, the experimental arrangements are easier to make with induction motors than with dynamos, while the accuracy of the method is a greater boon with three-phase plant than with direct-current machinery, owing to the greater complication of the testing, and to the fact that alternating-current instruments are not so satisfactory as those for direct-current.

[In an appendix to their paper, the authors gave four tables of results obtained by these methods of testing three-phase motors. The trials were made at the Witton Works of the General Electric Co. during April and May last. The power factors calculated from the ratio of the two-wattmeter readings agreed fairly well with the ratio between the apparent and true watts. The power factors given were those obtained from the ratio of these wattmeter readings.]

STANDARDS FOR ELECTRICAL MEASUREMENTS.

Report of the Committee, consisting of Lord Rayleigh (chairman), Dr. R. T. Glazebrook (secretary), Lord Kelvin, Profs. W. E. Ayrton, J. Perry, W. G. Adams, and G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, Profs. J. D. Everett, A. Schuster, J. A. Fleming, and J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, Prof. S. P. Thompson, Mr. J. Rennie, Principal E. H. Griffiths, Sir A. W. Rücker, Prof. H. L. Callendar, and Mr. George Matthey.

(Read in Section A.)

The Committee are glad to report that during the year considerable progress has been made with the construction of the ampere balance. Mr. L. Oertling has constructed the weighing mechanism, which has, however, not yet been taken over by this Committee, and the electrical parts of the instrument are nearing completion in the workshops of the National Physical Laboratory. The following particulars of progress and of applied tests may be of interest.

1. *The Weighing Mechanism.*—The castings, rods, tubes, screws, &c., intended for this had their magnetic permeability determined, and no part used in the construction has a permeability differing from unity by more than 0·001 per cent.

The balance was examined for stability and sensitiveness at Messrs. Oertling's works with satisfactory results; a difference of one-tenth of a milligramme may be detected.

2. *The Marble Cylinders and Fittings.*—Insulation and permeability tests were made on various samples of marble early in the year; eventually First Statuary Carrara Marble was chosen as most suitable for the work. An experimental marble cylinder was wound with a double helix and the insulation satisfactorily carried out; results of the tests leave little doubt as to the advantages of the double helix. The winding of both suspended cylinders has now been completed, and it is anticipated that the fixed cylinders will be finished in September. The linear measurements and insulation tests have yet to be made. Unless unforeseen difficulties arise, the balance equipment should be completed, and the whole ready for preliminary observations by the end of the year.

During the early part of the year Mr. F. E. Smith completed his researches into the construction of a mercury unit of resistance, of which some account was given in the last report. The results have been communicated to the Royal Society and are being published in the *Philosophical Transactions*. The values of the various tubes (11 in number) are very accordant, and a mercury standard of resistance of a high degree of accuracy now exists. Since the completion of his work the specification of the Clark cell has engaged Mr. Smith's attention, and a detailed account of his work forms an appendix to the present report. Mr. Smith has amply confirmed the result of previous investigators that the greater part of the difficulty in obtaining entirely concordant results for the various of cells set up by different experimenters is due to the mercurous sulphate. He describes three methods of preparing the paste which lead to identical results, and which have the advantage that cells set up with these pastes have the same E.M.F. within one or two hundred thousandths of a volt immediately after manufacture. In the first method due to Prof. Divers and Mr. Shiridzu the paste is prepared by the action of fuming sulphuric acid on mercury; in the second, following Prof. Carhart, it is prepared by the electrolysis

of weak sulphuric acid and mercury ; while in the third mercurous sulphate is dissolved over a water bath in sulphuric acid. The acid solution is then poured into a large volume of distilled water and the mercurous sulphate is precipitated in a pure form. In all cases it is important that, as advised by Mr. Swinburne and Prof. Carhart, the salt should be washed, for a Clark cell, with zinc sulphate, and for a cadmium cell with cadmium sulphate, and not with distilled water. Mr. Smith is continuing his inquiries and hopes shortly to be able to issue a complete specification for Clark and cadmium cells. The completion of the ampere balance will enable an absolute determination of their E.M.F. to be made.

The Committee regret to report that no further progress has been made, since its last report, with the experiments to determine the permanence and reliability of the platinum resistance thermometers described in that report.

It was pointed out last year that a special resistance box was required to enable the work to continue; unfortunately, the funds necessary for its purchase were not forthcoming, and the work has remained stationary for a year,

The Committee would consider it most unfortunate if work of a very real importance on which a start has already been made, and for which considerable funds have been expended in the purchase and investigation of pure platinum wire, should lapse for want of support, and they trust that their recommendation in favour of the continuance of the work may this year be accepted.

Meanwhile they would call attention to the very complete comparison up to a temperature of 1,000° C. between the constant volume nitrogen thermometer, the platinum resistance thermometer, and the platinum—platinum-rhodium thermo-couple communicated recently from the National Physical Laboratory to the Royal Society by Dr. Harker.

The Committee have received a cordial invitation to co-operate in the Electrical Conference at St. Louis during the forthcoming autumn, and have asked Prof. Perry and the secretary, who are attending as delegates of the Institution of Electrical Engineers, to represent their views on two questions of special interest.

The first of these relates to a proposal by Prof. Carhart to substitute the saturated cadmium or Weston cell for the Clark cell as a recognised standard of E.M.F. The Committee are aware that the fact that the temperature coefficient of the cadmium cell is one-twentieth of that of the Clark cell offers many valuable advantages, but in view of the fact that experiments designed to lead up to a satisfactory specification of the cell are in progress at the National Physical Laboratory, and that the completion of the ampere balance would enable the absolute E.M.F. of the cell to be determined, the following resolution was passed at the last meeting :—

"The Committee is not prepared at present to displace the Clark cell, and prefers to wait for the conclusion of the experiments at the National Physical Laboratory, and with the new balance, before coming to a decision as to the value to be assigned to the E.M.F. of the saturated cadmium cell."

The second question relates to certain proposals as to nomenclature which are to be brought forward by Dr. Kennelly. These are (*a*) that a systematic nomenclature should be agreed upon for magnetic units, and (*b*) that the prefix "Abs" should be used to indicate that a unit is given in the absolute CGS electro-magnetic system, and "Abstat" to indicate that the unit in question is in the absolute CGS electrostatic system.

Thus, an Abs volt would be the CGS electro-magnetic unit of E.M.F., and "Abstat" volt the CGS electrostatic unit of E.M.G.

These proposals have been discussed by the Committee, which has agreed to the following resolution :—

"With regard to the choice of magnetic units, the Committee is of opinion that the only two systems which need to be considered are the CGS system and the ampere-volt-ohm system, and that the quantities to be named of any are—

(1) Magnetic potential.
(2) Magnetic flux.*
(3) Magnetic reluctance.

Of the above two alternatives, the Committee is in favour of the CGS system as that on which to base any nomenclature of magnetic units, but is of opinion that a system of nomenclature is not called for."

The Committee disagrees with Dr. Kennelly's prefixes for the absolute electro-magnetic and absolute electrostatic systems of units, and expresses the opinion that no system of prefix should be employed in which each prefix does not bear some definite numerical signification.

In view of the work still necessary with regard to the ampere balance, the cadmium cell, and the platinum standard of temperature the Committee recommend that they be reappointed, with a grant of £50, that Lord Rayleigh be chairman, and Dr. R. T. Glazebrook secretary.

* The name "Maxwell" was recommended by the Paris Congress, 1900, as the name of his unit, and this recommendation was adopted by the Committee at Bradford.

APPENDIX I.

On Anomalies of Standard Cells.. By F. E. SMITH.

From the National Physical Laboratory.

During the past two years certain anomalies of Clark and of cadmium cells have been under investigation at the National Physical Laboratory. The work is still far from completion, but the essential results so far obtained are given in this paper.

In March, 1902, some experiments at Bushy House resulted in the isolation of the depolariser employed in both standards as the great disturbing element. Mr. Swinburne arrived at the same conclusion in 1891,* while recently, in America, Prof. H. S. Carhart and Mr. G. A. Hulett have traced the variations in E.M.F. of the cadmium cell to the same source. A new specification of the mode of manufacture of the paste was thought to be desirable, and this problem was the first to receive attention.

In order to be independent of the variations of the other elements, cells were constructed of a type indicated by the arrangement—

$$\underset{}{\text{Hg} - \text{Paste} - \text{Solution and crystals} - \text{Paste} - \text{Hg},}$$
$$\underset{(a)}{\qquad\qquad\qquad

the directions of the curves H K and K R, shown after the observations of November 2nd, while none is shown in H R; the deflections consequently indicate that the element K must have changed in an abnormal fashion. Indeed, between November 2nd, 1903, and July 9th, 1904, the E.M.F. of the K group apparently increased by at least 0·0003 volt—a rise of exceptional magnitude. A fall in voltage is the usual feature.

The fact that the E M.F. of a cell had changed by as much as 0·16 per cent. was very disconcerting. It is true that a difference between H and R was anticipated, for H was a pale yellow colour, while R was grey. On the other hand, the paste K was also slightly yellow, yet no such difference is observed between K and R. It was thought that the mode of manufacture of the sulphate might influence the properties of the product. Mercurous sulphate is often prepared by precipitation, either $Hg_2(NO_3)_2$ and Na_2SO_4, or $Hg_2(NO_3)_2$ and H_2SO_4 being employed; traces of the resulting nitrate in the final product would certainly introduce a disturbing element. Again, mercurous nitrate is often associated with a basic nitrate, and basic salts are to be avoided, as will afterwards be seen. Samples of the salts were prepared by these precipitation methods, and the results were far from satisfactory. Two samples of the sulphate were also obtained from the same manufacturer; the Clark cells prepared with these, differed in E.M.F. by 0·0004 volt; each was subjected to the same treatment and there was no observable difference in colour.

A more satisfactory specification of the depolariser being desirable, other modes of manufacture eliminating the above troublesome elements were sought. Concentrated sulphuric acid and mercury react very slowly at ordinary temperatures, but much more rapidly at temperatures approximating to 300° C. The resulting salt is associated with H_2SO_4, which probably is not very difficult to remove if the salt be in a fine state of division. Dr. Muirhead has prepared mercurous sulphate in this way, and forwarded two Clark cells containing the product to Bushy House. A second method of preparation, due to Divers and Shimidzu, is reported in the *Journal of the Chemical Society* (47, 639). Briefly, pure mercury and fuming sulphuric acid saturated with SO_3 are brought into contact. They react in the cold, though there is no visible evidence for some time, owing to the solubility of the product in the liquid; the acid also becomes saturated with SO_3. If the main portion of the liquid be removed from the salt, this latter may be freed from SO_3 by warming; mercurous sulphate associated with H_2SO_4 is thus obtained. The acid is removed by washing. Dr. Carpenter has prepared five samples of the salt in this way; they were made from five lots of the fuming acid from different manufacturers and mercury distilled *in vacuo* at the laboratory. These sulphates were examined in four limb cells of the cadmium type; the results of the observations are given in Table II. The standard of reference is cell No. W 17, a cadmium cell more than two years old and known to have changed but little since its manufacture.

Table II.—*E.M.F. of Cadmium Cells minus E.M.F. of W* 17.

Differences in hundredths of a millivolt.

Date of observation.	Cell No. 52.			Cell No. 53.			Cell No. 54.		
	a.	*b.*	*c.*	*a.*	*b.*	*c.*	*a.*	*b.*	*c.*
1904.									
April 4	+38	−21	−19	+38	−14	−13	+38	+14	−18
April 18	+35	−30	−20	+39	−13	−14	+35	+13	−18
May 3	+30	−43	−20	+32	−14	−14	+34	+12	−19
June 13	+27	−50	−21	+32	−14	−14	+34	+10	−19
July 9	+23	−54	−21	+30	−14	−15	+34	+10	−20

The pastes 52*a*, 53*a*, 54*a* were prepared with the same sample of Hg_2SO_4; it was purchased and prepared in a similar manner to the sulphates dealt with in Table I. 54*b* was also a purchased sulphate. The remaining specimens were prepared by Divers's method.

It will be observed that all the pastes change so as to reduce the E.M.F. of the cell; but whereas the E.M.F. of the cells prepared with purchased sulphates is greater than that of W 17, those made up with the Nordhausen sulphates have in each case a lower E.M.F. Cell No. 52*b* is exceptional in the fall of its voltage. The difference in the prepared pastes, though small, condemns part of the method of preparation, and further investigation became necessary.

The method of preparation adopted by Dr. Carpenter was at first repeated. Close observation showed that on formation the sulphate cakes considerably, and is accompanied at the surface of contact with the mercury, by a compound of a light brick-red colour. If, without freeing from the acid or SO_3 the product is added to distilled water, reduction of part of the sulphate apparently occurs, mercury is precipitated as a black powder, and the red compound entirely disappears. (The mercury thus precipitated is a valuable addition to the paste, the conversion of mercuric sulphate to the mercurous condition being rendered possible by its presence.) The salt produced by freeing the first product from SO_3 also loses the brick-red tint, and is finally obtained as a pure white paste. On prolonged washing with water, however, hydrolysis results, and the colour changes to pale yellow. Two samples of hydrolysed mercurous sulphate were thus prepared, the one being washed for one hour with water, and the other for 24 hours. An experimental cell indicated that the more hydrolysed product, if employed to set up a cadmium cell would cause the E.M.F. of that cell to be greater by 0·00064 volt than if prepared with the first sample. The presence of this hydrolysed product is therefore to be avoided, and washing by water prohibited.

(*To be concluded.*)

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Yacht" writes:—"Being a subscriber to your very valuable paper for a number of years, I have taken the liberty of sending for your perusal some cuttings from the *Lowestoft Journal* concerning our business. Perhaps you would not mind giving your views on the various points raised. I am a native of the district, and on returning here some four years ago, I was constantly asked to arrange for the lighting of this neighbourhood, being an electrical engineer by profession. My reply was invariably, "What about capital?" as I was but engineer-in-charge of a large works installation and possessed very little capital. To cut the story short: meeting an old friend, a mechanical engineer, we put our heads and money together, bought an engine and boiler, and in our spare time repaired and re-modelled it for the work in hand. One of our supporters generously paid for the dynamo—one of the best procurable—and we commenced supply. Our first quarter's revenue was £10; coal bill, £12; no night supply after 12 o'clock. Eventually we added a battery of 135 Chloride cells, and extended our switchboard. Later on we purchased another dynamo, and eventually a fine condensing engine and loco. boiler—we have now been running three years and we supply about 60 consumers. We have the equivalent of about 1,800 8-c.p. lamps connected. Our revenue last March quarter was £96. This quarter, according to present output, we hope for about £120. We have an abominable sanitary arrangement here, and a drainage scheme was prepared by the rural authority. This was put aside and urban powers were granted to the place to look after its own affairs and to make good sanitary arrangements, and provide pure water. The Urban Council has now shelved this scheme, and wants to procure a provisional order for the supply of electricity. Lowestoft is at the bottom of this. The Lowestoft Council has obtained permission to lay a cable to Oulton, and, of course, would like to capture this place for the purposes of supply. The Councillors say they do not intend to work the order if they get it, but simply to stop us from getting it. On this statement, how would our application be received by the Board of Trade? The Councillors say they recognise the fact that it will be a loss to the ratepayers for 20 or more years, but that it will be a valuable asset in about 25 or 50 years. I ask—Why should we pay taxes for a benefit which will accrue 25 or 50 years hence? Can you give any information as to whether, and how, the Bermondsey clause, or any other clause, could be inserted in the proposed provisional order?"

* * * "Yacht's" fear appears to be that if the Urban Council in his district applies for a provisional order it will estop him from obtaining such an order, and that, if he is prevented from obtaining a provisional order, his present installation may be rendered useless. It is conceived, however, that his position is not one of any grave peril. If the application for a provisional order is opposed—and a *locus standi* to oppose will be conceded to "Yacht," it is very doubtful whether the Board of Trade will grant the application, having regard to the installation now in existence. It is feared, however, that if "Yacht" makes an application himself he will be under a difficulty, because the Urban Council would be able to place its veto upon it, unless the Board of Trade saw fit to dispense with the consent of the Urban Council.

There is another course open to "Yacht," which he will do well to consider carefully. Let him not trouble himself about provisional orders, but simply continue his present system of supply. It appears that his consumers and the people of Oulton generally are satisfied with the existing arrangement, and they will no doubt be prepared to help him in every way. Let him therefore be careful to so arrange his mains (if it is possible to do so) that they do not cross, either over or under any highway repairable by the Urban Council. Provided he does this, the Council will have no power to touch him, *whether it obtains a provisional order or not.* If it is necessary to cross a highway, let him get the consent of the landowners on either side at the desired point where he can erect his posts, and then suspend the cable at a considerable height, so as to be out of reach of any possible traffic. If the cables which are now erected comply with this requirement, it is very doubtful whether the Urban Council could touch him.

The above remarks are based upon the supposition that the Urban Council has not adopted the Overhead Wires Act, which may have given it express jurisdiction to prevent cables being suspended, in any circumstances, over a highway.

With reference to the Bermondsey clause, even if this could be inserted in the provisional order now sought by "Yacht," it would not assist him in any way.

Civils Leave for St. Louis.—A large number of the members of the Institution of Civil Engineers left Liverpool on Saturday by the Cunard liner, *Etruria*, for New York, *en route* to the St. Louis Exhibition.

E

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

An Innocent Abroad.

I am moved to write you by the very quaintness of this place which, though only a few hours from London, might be much further to judge by its extreme quaintness. Though one of the chief manufacturing towns of Belgium, the appearance of the place takes one back to the middle ages. I am here testing a Diesel engine at the works of La Société Anonyme des Carels Frères. The works are down by the docks. I must tell you that though Gand is an hour's run by a decently fast train from Ostend, that only stops at Bruges, it has communication with the sea, by means of the most excellent canal system, to which you recently referred in the Electrical Review, for ships of, I believe, 2,000 tons. Improvements are in progress now, or shortly, which will enable ships of 3,000 tons to come up to Gand from Terneuzen. I merely mention this in passing, in order to add some emphasis to your recent article, and the arguments there put forward as to the great desirableness of improving the depth, width, and status of the canals of England. Gand is a town of but 50 to 60 thousand inhabitants, yet it has a ship canal of the above very liberal capacity. The works of Carels Frères are a striking example of the fact that it is not necessary to cast away all mediæval picturesqueness from a town in order to have first-class engineering works in it. Belgium is practically a free trade country, and, nominally, they should suffer as much as we do in England from dumping. I find that German forgings are "dumped" in Belgium, and are welcome here as enabling the Belgians cheaply to produce finished goods of a higher grade. Messrs. Carels Frères are noted for their castings. I have been all through their shops and inspected the work both for Diesel engines and regular steam engines, and amongst the lot I have found one small blown, or faulty, spot, and that was not in an important place. And for this excellent work the iron used is just English, and the castings from this English iron are better than one usually would find in an English shop. Obviously, therefore, our English coke being better than any other, there is no reason beyond skill and techno-chemistry why our foundries at home should not do equally good work all round. This works, otherwise, is something of a model also. The light is as good as can be; there is ample room, and yet the construction is not needlessly heavy or costly, and contrasts with the unnecessary costliness of some of the German works.

A large number of the machine tools are English. In the works, the chiefs speak French and English, the workmen usually Flemish, and there is, therefore, a good deal of polyglot conversation. I think it is the contrasts here that make the place so interesting. Coming away from the works, and through older parts of the town, reminds one of some of the old towns in Brittany, only more so. Gand, in fact, has in it a touch of Rouen, something of Amsterdam, and not a little of Dublin. Amongst all these bits of Gand the extreme picturesqueness is not put in the way of a certain amount of utility. There is an electric tramway here, the gauge may be a metre but it doesn't look so much. There are overhead wires, but the cars run about with their trolley-poles lashed down, and I find that the panels of the cars are on hinges, and conclude that the pernicious or pernickety accumulator lurks beneath the seats. The overhead equipment is, I am informed, new, and cars will soon be run without the accumulators. Churches that look as though they had been built in late gothic times, are apparently not looked down upon as places to which the harmless necessary "rosette" may be attached, only they do not here call everyone's attention to the point of attachment by putting a rosette round it. Municipal officials at home are never happy unless they can compel someone to go to the expense of calling the maximum of attention to every detail of overhead work by the use of rosettes and a plethora of collars and scroll-work, as useless as it is unnecessary. They always carry the conviction of a poverty of design, and remind one of the mouldings round the domes and sand-boxes of American locomotives, only just discarded in favour of plain English styles. Perhaps in good time the ideas of the overhead designer or the municipal surveyor will undergo the same chastening process, and there will be a chance then for a decently-made, properly-formed taper English pole without the weak S.S.S. telescope joint, whose ugliness is such that a collar is thought necessary to hide it, and to deceive the public eye into believing that there is a continuous taper beneath.

The boats which run over to Ostend from Dover are Belgian owned, and are fitted with Marconi apparatus. The external manifestation of the Marconi system is three wires stretched fairly tightly between two horizontal bars about 4 or 5 ft. long. These bars are attached by an insulated wire near the heads of the fore and mizen masts—there is no main mast. At one bar the three wires extend downward to the operator's cabin, and a message can be sent for 2s. + 2d. per word.

To return to the works, there are three main departments. One is devoted to stationary engines, of which the firm make the Sulzer type. All cylinders are sheeted in "Russia" planished iron, and superheated steam can be used up to any reasonable temperature without variation of construction, and as low as 10 lbs. of steam can be guaranteed per I.H.P.-hour.

In another shop locomotives are made for the Belgian State Railways, and in a third new shop the Diesel engine is made. In the latest type the air-pump does not, as formerly, receive its air from the air compressed by the main piston, but there is now a compound or two-stage air pump, which is helpful to efficiency.

Between the two stages is an inter-cooler, from which a good deal of the moisture of the air compressed in the first stage pump, is extracted.

It might be added that by adhering to good work Messrs. Carels Frères are always busy. Even in the very bad time of two or three years ago they were not only fully employed throughout, but even took on men. And Belgium is a country whose customs are so light that it forms practically one of the most convenient of dumping grounds. This is pointed out simply for general information.

Engineers might do worse than run over to Gand.

X.

Gand, *August 30th*, 1904.

Electrical Rock Drills.

Concerning "Quarry Owner's" letter in the "Correspondence" column of your current issue, I can furnish an electrically-operated percussion drill, and am prepared to pit the same for a sum of money against any electrically-driven percussion drill from America or elsewhere—for rapid boring, durability, economy of operation, and handiness.

A. H. Gibson.

Station Avenue, Kew.

[Various communications, addressed to "Quarry Owner" in reply to his letter of last week, have been forwarded to him.—Eds. E.R.]

The New Patent Law.

The Board of Trade has just issued an order, bringing into force on January 1st next, the Government examination system for patents set forth in the Patent Law of 1902, and from January 1st, 1905, reducing the period of provisional protection from nine months to six. The system of examination thus instituted is much less perfect than those of other countries, as the examiner has merely to search through the British patents of the immediately preceding 50 years to see if in these there be, in his opinion, any anticipation of the invention set forth in the complete specification. This report is forwarded to the Comptroller, and if the Comptroller be of the opinion (from this report) that the invention is partly or wholly anticipated, the applicant is informed of the anticipation, and has the option of a personal hearing, or of amending the specification to the satisfaction of the Comptroller, or, in default of either, the Comptroller determines whether a reference to any, and, if

so, what prior specifications must be made in the specification by way of notice to the public. Against his decision there will be an appeal to the law officer. The examiner's reports will be kept strictly secret from all but the applicant and his agent, but this examination must not be held in the slightest to guarantee in any way the novelty of the invention, or the validity of the patent, as, of course, the prior publication of the invention in other documents open to the public in England prior to the date of the application, or the prior public use of the invention, would be equally as fatal to the validity of the patent as the publication of the invention in a prior British specification.

W. P. Thompson & Co.,
Chartered Patent Agents.

6, Lord Street, Liverpool,
September 1st, 1904.

Unfair Competition.

After reading the letters of "B." and "Educated Mechanic," I decided to add my own experience to the list. I can quite endorse all that they say on the subject. I have been disengaged for 10 weeks, and have, during that time, applied for some three or four dozen situations advertised vacant. To *not one* of my letters have I received a reply, although I have a good experience and references. As to applying personally at the various workshops it is quite useless. In nine cases out of ten it is impossible to see anyone in authority. Even if one does, one is generally told to send in a written application, which doubtless goes straight into the W.P.B. Advertisements such as Nos. 8934 and 8905 in ELECTRICAL REVIEW of September 2nd fully explain why this should be so.

Fair Play.

Having read the letters in your valuable paper under the above heading, I would like to add a few remarks. During the last few months I have answered dozens of advertisements regarding a situation, and up to the present have only had one reply. I would like to suggest that if advertisers get so many replies that they cannot spare the time or go to the trouble to answer each applicant separately, why not insert a shilling advertisement in the same paper in reply to the unsuccessful people? This method would be cheap and satisfactory.

A few weeks ago the writer cycled 40 miles, in answer to, and to make personal application for, an advertised vacancy. The following conversation took place :—

"Good morning! I've called about the vacancy you are advertising."
"You must go back and write to us, sending full particulars."
"Your advertisement didn't say so."
"No, but I can't tell you anything about it."
"I thought personal application would be much the better."
"Yes, but you must write, and we will consider your letter; sorry, good morning."

I don't know whether they have yet considered the letter, but I have not had an answer.

I do not want to infer for one moment that all employers are alike, because I have seen a good many, and know some that treat men, though out of work, as gentlemen; and they have the thanks of one who has been a great many times

Disappointed.

Electric Lighting Accounts.

You give a short review of a recent publication treating of electrical lighting accounts, which, as you very justly say, puts the matter in a very simple and concise form. Were it to stop at book-keeping, no doubt it would be a valuable work of reference for those who were not trained accountants.

There are, however, matters which would be far better left untouched, or only referred to as requiring expert handling by those better able to deal with them (by reason of experience gained in those particular lines), than merely through the books and by rule-of-thumb. It must be understood that to give figures as standards for depreciation and renewals is tremendously dangerous, and these should be eliminated in the next edition.

How can an accountant in the first place judge as to the life of plant, and electrical plant above all others? Even experts cannot lay down a hard and fast rule which could apply to each and every installation.

Many cases could be quoted to show how utterly fallacious such figures are, as appear in Mr. Johnson's book; one will, however, perhaps suffice. He gives 2½ per cent. for buildings. Nothing could be more absurd than to apply this rate to a corrugated iron building in an acid and sulphur-laden atmosphere, being the same as applied to a strong stone or brick building under similar or better conditions. One might criticise the other headings just as severely—but space forbids.

The only safe and proper way for accountants, either for a private concern or public bodies, to ascertain what is the proper amount to be brought into his calculations, is to have the plant, buildings, &c., periodically examined and independently valued by those whose profession it is to do so, and who can be relied upon to give accurate figures according to the state of affairs as they find them.

This would relieve the directors or committees of all responsibility, and prevent many grave errors being made, as would be if "template" figures were used, as suggested by the author of the book you review.

Ajax.

September 6th, 1904.

REVIEWS.

The Telephone Service: Its Past, Its Present, Its Future. By HERBERT LAWS WEBB, M.I.E.E. London: Whittaker and Co. Price 1s.

In his introduction, the author states that he has endeavoured "to describe in plain language the general features of a modern city telephone system, and the principles which govern the cost of production of the telephone service." The endeavour has been successfully accomplished. The language is plain, but eloquent, and the descriptions are clear and practical.

In brief chapters, the author traces the development of the telephone system from "The Rise of a New Art" through a discussion of the features of "Efficiency and Development" to a description of "The Modern Telephone Exchange," with "The Multiple Switchboard and the 'Engaged' Test."

A perusal of the last-mentioned chapter by telephone users would do a great deal to satisfy irate subscribers, whose unbelief is proverbial, and is usually expressed with emphasis. As Mr. Webb says, "The rapidity with which an operator discovers that the line of a subscriber wanted is 'engaged,' compared with the time it takes to obtain the attention of the subscriber when the line is not engaged, is a perennial mystery to the telephone user."

Why the telephone service is more costly, and therefore should be charged for at a higher rate in a city than in a village is explained in a chapter on "Large and Small Telephone Systems," whilst "The Telephone Subscriber" indicates the share in the operation of the system which the user performs, and though it is shown that in modern systems the subscribers' duties are almost automatic, there is still some excellent advice on telephone etiquette for the subscriber to absorb. "Tragedy and Comedy of the Telephone" is a chapter which lightens the way for the lay reader. "Telephone Tariffs" is a plea for the message rate system, and the recognition of the "message-mile" as the unit of cost, instead of the instrument, as on the flat rate. The two final chapters, "The Telephone in Great Britain" and "Future Possibilities," argue strongly against State telephones, and put in a claim for a "freedom of trade" which may, to some, seem somewhat inconsistent with the requirements laid down in earlier chapters.

The continuation of the paragraph in the Introduction which we have already quoted is :—"It is hoped that these descriptions will be useful to the telephone user, as such, and to the reader who is interested in the working and development of that most magical of modern electrical industries—the telephone service." In the main we fear the telephone user is the "general reader," who takes but little pains to

obtain useful information, but those "interested in the working" of the telephone will be glad to add this interesting and inexpensive work to their libraries.

Those who have studied the science of the service will not expect to find a great deal of new material, but they cannot fail to appreciate the agreeable way in which the underlying principles, rather than the engineering details, are crystallised and described. We venture to think that to many engaged in practical telephone work this little book may convey something akin to inspiration as to the service which their subscribers are entitled to receive, and as to the means and methods by which such service may be given.

Modern Machine Shop Tools. By W. H. Van Derwort. London: Crosby Lockwood & Co. 1904.

This book well answers to its title, being a description of the tools, both hand and machine, in ordinary use in the workshop. Commencing with the hammer and chisel, the author takes in turn files, scrapers, surface plates, standards of measure and gauges, calipurs, including micrometers as well as indicators, rules, squares, saws, drills, and so on through the whole range, passing on to screwing tackle, and so on to machine tools. He deals also with the details such as modes of fastening, with grinding, gearing, belting, and power transmission. Not only does he describe tools, but also the mode of using them, their treatment, cleaning, grinding, and so on. Indeed, the half thousand odd pages constitute quite an encyclopædia of the subject.

Perhaps here and there the information is a trifle scanty. Thus in the chapter on "Milling Cutters," we find plenty of cutters pictorially illustrated, and on some of which the dimension appears we can count the teeth and learn the tooth spacing by calculation, but we find no reference to teeth numbers, and no discussion of this important detail. More might with advantage have been given on the subject of limit gauges and English practice introduced. The illustrations are all of American gauges, and there is a certain clumsiness which is absent from English-made tools. Witness the illustration on page 90, and compare with the products of the Newall Engineering Co.

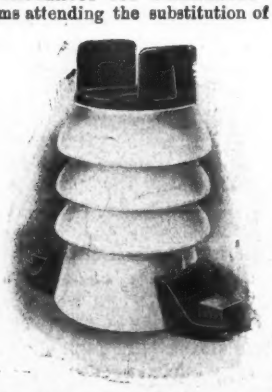
On the other hand, we find no description of the pipe thread stocks which are made by one firm in America to great perfection, strong and yet light.

This book should certainly be in the hands of the apprentice engineering workman. He will gain much useful information from its pages, and will not go far astray by following it, while at the same time he will be able to modify and vary his practice away from the strict lines of the book, as experience enables him to form correct judgements for himself.

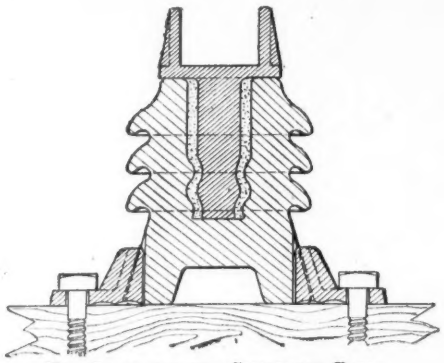
We know of no book which, taken as a whole, so satisfactorily treats the subject of shop tools.

BUSINESS NOTES.

Improved Insulator for Conductor Rails.—Among the many problems attending the substitution of electric power for steam locomotion in railway working, of no small importance is the attainment of a thoroughly satisfactory means of supporting and insulating the conductor-rails. It is essential that the rail supports, while providing permanent insulation under the difficult conditions prevailing on railway tracks, should be substantial enough to withstand rough usage and sufficiently strong mechanically to resist considerable vibration and shock. With a view to meeting these requirements, Messrs. Doulton & Co., Ltd., of Lambeth, who have had considerable experience in the manufacture of insulators of this class, have patented a new rail support. It consists of a pedestal of porcelain of substantial proportions with a large base resting direct upon the rail-tie and secured thereto by external malleable-iron fastenings. In this respect it differs considerably from earlier types of rail insulators in which the porcelain is supported on a central stud, after the manner of telegraph insulators. The conductor rail is held in position by a chair of malleable iron, provided with a depending stud which is cemented into a recess in the insulator. The insulator shown in the illustration is fitted with a chair for a conductor rail of rectangular section. The same type is supplied with chairs adapted for other sections of rail, *e.g.*, flanged or channel sections. The insulator is of high-grade vitreous porcelain of a form well adapted for manufacture, and it will be seen from the illustration that it occupies the whole of the vertical space below the rail, thus presenting a maximum length of path to resist surface leakage of current.



New Insulator for Conductor Rails.



New Insulator for Conductor Rails.

Electrical Wares Exported.

Week ending September 8th, 1903.		Week ending September 6th, 1904.	
Adelaide	Value £206	Alexandria	Value £96
Alexandria	46	,, Teleg. mat.	415
Amsterdam	20	Amsterdam	53
Antwerp. Elec. fuses	325	Antwerp. Elec. fuses	379
Auckland	135	Brisbane	541
Bombay	21	Buenos Ayres. Teleph. cable	869
Boston	23	Calcutta	406
Calcutta	3,885	,, Elec. machinery	181
Cape Town	340	Canary Islands	14
Coronel	42	Cape Town. Elec. machinery	613
Dunkirk	142	,, Teleg. mat.	245
Durban	1,168	Colombo	71
,, Teleg. mat.	155	Copenhagen	6
East London	1,335	Durban	1,203
,, Teleg. mat.	563	,, Elec. machinery	886
Gibraltar	16	East London	95
Hamburg	25	,, Elec. machinery	1,257
Hong Kong. Teleg. mat.	23	,, Teleg. mat.	61
Lisbon. Teleph. cable	50	Flushing	36
Maceio	33	Fremantle	241
Madras	246	,, Elec. machinery	329
Melbourne	36	Gibraltar. Teleg. mat.	75
Pernambuco	44	Hamburg	5
Perth	419	Karachi	250
Port Elizabeth	55	Larache	70
Rangoon	168	Lisbon. Teleg. mat.	461
Rotterdam. Teleg. mat.	40	Lyttelton. Elec. machinery	130
St. John, N.B.	52	Madras	84
St. Petersburg	307	,, Telephones	210
Shanghai	119	Melbourne	154
,, Teleg. mat.	32	,, Teleg. mat.	43
Singapore	117	Newport News	85
Swimam	50	Ostend	20
Sydney	528	Otago	63
,, Teleg. mat.	399	Penang	366
Townsville	180	,, Teleg. mat.	290
Yokohama	21	Pernambuco. Elec. machinery	162
		Perth	116
		Piræus	45
		Port Elizabeth. Teleg. mat.	264
		Rio Janeiro	260
		Rotterdam	27
		,, Teleg. cable	215
		St. Petersburg	71
		,, Teleg. cable	1,260
		Santiago	37
		Shanghai	341
		Sierra Leone	9
		Singapore	2,015
		,, Teleg. mat.	79
		Sydney	1,069
		,, Elec. fuses	35
		Wellington	274
		Yokohama	138
		,, Elec. light wire	967
Total	£11,490	Total	£17,588

Foreign Goods Transhipped.

Ostend. Elec. goods	Value £88	Alexandria. Elec. mat.	Value £28
		Durban. Telephones	879
		Rio Janeiro. Elec. fittings	205
		Total	£1,112

A Direct-Reading Insulation Meter and Testing Set.—Mr. Robt. W. Paul, of 68, High Holborn, W.C., has introduced an exceedingly handy testing set which combines several novel features in constructional details. Fig. 1 shows this instrument with the lid removed. The galvanometer, universal shunts, switches, &c., and, in fact, all the apparatus are fixed on to an ebonite slab, which can be lifted out on removing certain screws, facilitating rapid investigation in case of need. The galvanometer is Paul's single-pivot, moving-coil type (described in a recent issue of the ELECTRICAL REVIEW), of which a special feature is that it does not require levelling and is practically dead beat. The construction admits of the automatic raising of the coil from its pivot on closing the lid of the case, thus freeing the instrument of liability to injury during transit, &c.

The scale of this instrument is shown in fig. 2, the divisions on the lower part corresponding to micro-amperes and those on the upper, reading direct in megohms at 100 volts. For lower readings down to 10,000 ohms the shunts are employed, when the megohm reading divided by the shunt power used gives the result (or for greater accuracy, with very low insulations, the resistance of the set can be subtracted). Any other pressure up to 500 volts may be used, when the reading is multiplied by the simple factor, pressure/100. The universal shunts are chosen so that large scale readings are always obtainable, and the internal resistance of the standard pattern insulation meter has been fixed at 20,000 ohms, which remains practically constant whatever shunt value is employed. It will be noted that an extra pair of terminals are fitted below the scale opening, which may be independently utilised for locating faults either by the loop or fall of potential methods, also for comparing low resistances, pressures, &c., in fact, the latter may be measured direct on the instrument, if required. The instrument is very compact, and the switches and fittings generally are well constructed mechanically.

The firm also turn out a Mains Testing Set, very similar in appearance to the last-described one. Its points of difference are that a suspended coil galvanometer is substituted for the pivoted type; the levelling which is necessary with this type of instrument being easily effected by means of two screws on the face, instead of as frequently by an external adjustment difficult to get at. In this

FIG. 1.—DIRECT-READING INSULATION METER AND TESTING SET.

instrument the scale is divided into 55 divisions on each side of the central zero; the universal shunts are suitably proportioned, and the standard internal resistance is 100,000 ohms. A special switch can be fitted to vary the latter resistance, but due allowance must then be made for the varying internal resistances when employing different shunt powers. Separate terminals are also fitted with this instrument, making the galvanometer (with shunts) available for small current and pressure measurement, &c., and for loop or bridge tests.

Trade Announcements.—Messrs. Bray, Markham and Reiss, Ltd., of Blackhorse Lane, Walthamstow, have appointed Mr. David Alexander, 43, Mains Street, Waterloo Street, Glasgow, to be their sole agent for Scotland.

The Electrical Power Storage Co., Ltd., have appointed Messrs. Saunders, Todd & Co., of Maritime Buildings, King Street, Newcastle-on-Tyne, to be their agents for the Northumberland, Durham, and the Tees district, and Mr. J. W. Barnard, who is the sole agent for the E.P.S. "Q" and "V" type cells, has arranged to place the sale of the "Q" and "V" and small type cells in their hands for the above district, so that Messrs. Saunders, Todd & Co. may be in a position to deal with all types of batteries listed by the E.P.S. Co.

Messrs. Hubert Davies & Spain, electrical engineers, of Johannesburg and Durban, have just opened a London buying office at Salisbury House, London Wall, E.C. Mr. J. Hubert Davies is in charge.

The offices of the Tudor Accumulator Co., Ltd., were on the 3rd inst. removed from 16 to 19, Victoria Street, Westminster, S.W.

Messrs. Cutting Bros., electrical engineers, of Derby, have secured a site near the railway at Stamford, for the erection of works.

Steam Superheaters.—Messrs. Tinkers, Ltd., have sent us a leaflet of their steam superheater, which is one of the small tube type that has awakened to the folly of the cast-iron header, and is therefore wholly of mild steel. No particulars are given as to the relative area through the superheater tubes and through the boiler steam pipe—a figure that is necessary to be known before the working pressure before and after the superheater can be compared. Superheaters require something more than mere bundles of tubes, and too many of them wiredraw the steam from 12 to 25 per cent. owing to insufficient area. This area ought to be stated. A test pressure of 300 lbs. per sq. in. appears rather small for mild steel boxes that may reach 900° F. Otherwise this superheater consists of a cluster of pipe loops between two headers like all this class for the downtake position in the Lancashire boiler, but, as stated above, it avoids the ignorant error of the cast-iron header.

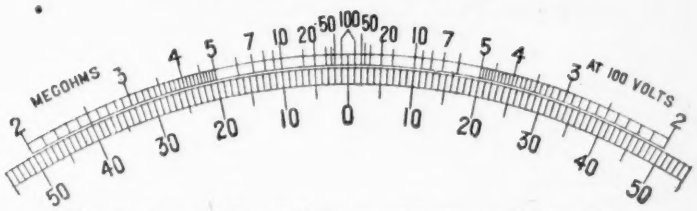


FIG. 2.—SCALE OF PAUL'S INSULATION METER AND TESTING SET.

Trade Marks in China.—Messrs. W. P. Thompson and Co., patent agents, write from Liverpool:—

"With regard to the important treaty which has been entered into between Great Britain and China, under which the Chinese Government undertakes to establish offices where trade marks can be registered, advices just to hand indicate that the regulations for carrying the undertaking into effect have been officially published. The British Government has assented to them, and the Japanese Government raises no objection; so that the regulations will, no doubt, be put into force if they are assented to by the U.S. Government. Briefly, the regulations are as follows:—

"Any person desiring to use a trade mark in China must first register the same according to these regulations. The Board of Commerce shall establish a bureau of registration. Every application must contain a statement giving a general description of the trade mark, the class and particular kind of goods for which it is to used. The application will be placed on file for three months, and advertised by the bureau, and if no one petitions against it, it will be registered. If two persons apply for similar trade marks, the first applicant will receive registration, but in the case of a trade mark already registered in a foreign country, the date of such foreign registration will be recognised, if application in China be made within four months. During the first six months of the establishment of the bureau, applications can be made for registration of trade marks already registered abroad, and the bureau shall recognise such trade marks as entitled to precedence. Any mark which has been publicly applied in China to a special article for more than two years before application for registration cannot be registered. Suits for infringement by foreigners against Chinese are tried by a local magistrate and the consul sitting together, but if both parties to the suit be foreigners, the Consular Court has jurisdiction. Penalties for infringement are very severe.

"It is believed that the new treaty will prove very useful, as trade marks that are registered will be more efficaciously protected from any infringement, but omission to register may involve loss of rights."

Petrol-Electric Railway Coaches.—We are informed that, in spite of very severe competition from manufacturers in America and other countries, the Wolseley Tool and Motor-Car Co., Ltd., of Adderley Park, Birmingham, have secured an order for a large six-cylinder petrol engine to develop at normal revolutions 140 B.H.P. The order has been placed by the General Electric Co., of Schenectady, New York, for the first of their new petrol-electric railway coaches. Very considerable interest has been manifested in America, as elsewhere, in the extensive experiments of the North-Eastern Railway Co. with their petrol-electric automotor railway coaches. These first two coaches have now, we understand, passed through all their extensive series of tests, and are running in public service between Scarborough and Filey. It will be remembered that the Wolseley Co. supplied two special 90-H.P. petrol engines for these coaches, after experiments had been made with several other types of motors. The North-Eastern engines have four cylinders 8½-in. bore by 10-in. stroke. The new ones for America are to be 9-in. bore by 10-in. stroke, six cylinders. It is said that, after the experimental run of the first engine, orders for a further considerable number of engines will be placed with the Birmingham company.

Private Telephone Contracts.—The tender of the Private Wire and Telephone Installation Co., Ltd., has been accepted for installing electric light, electric bells, and telephones throughout "Baltic House," a large building now in course of erection in Leadenhall Street, E.C. Among other contracts lately received by the same company may be mentioned installations for the hospital at Walton-on-Thames, the offices of the Equity and Law Life Assurance Co., of Lincoln's Inn Fields, Messrs. Batger's new premises in Whitehorse Street, Ratcliffe, and Messrs. Cooper, Dennison & Walkden's premises at Bermondsey.

Catalogues and Lists.—The Electric Construction Co., Ltd., of Bushbury Engineering Works, Wolverhampton, have issued a large hanging show-sheet with a view to keeping their various electrical machinery manufactures even more prominently before the eyes of engineers. A neatly-planned design embodies about a score of excellently-executed half-tone illustrations showing some of their 750-kw. traction generators, 1,500-kw. polyphase generators, 600-kw. two-phase sets, rotary converters, transformers, switchgear, and their different types of motors for colliery and machine-driving service. A bird's-eye view of the works appears at the head of the design.

An 8-pp. pamphlet has been received from the American Electrical Novelty and Manufacturing Co., Ltd., of Charing Cross Road, W.C., detailing their "Ever-ready" electrically-propelled clock. A very artistic design in colours embellishes the front cover, and excites an interest in the contents of the list.

A new circular issued by Messrs. Ernest F. Moy, Ltd., describes their type No. 68 triple-pole knife-switches for pressures up to 550 volts, in cast-iron cases.

We have received from the Edison & Swan United Electric Light Co., Ltd., three new sections of their catalogue, namely, Section I., "Royal Ediswan" Lamps; Section IV., Measuring Instruments; and Section V., Wires and Cables. Section I. contains illustrations showing all the latest forms of "Royal Ediswan" lamps, and embraces high and low voltage standard lamps, high candle-power lamps, "Queen" reflector lamps, obscured, tubular, crinkled and olive lamps, "Royal Ediswan" traction and ship lamps, and a large variety of special small bulb patterns, as well as focus, cell viewing and radiator lamps. Some useful information is also set forth at the commencement. Section IV. contains measuring instruments of all sorts; a large number of pages are devoted to the "Ediswan" gravity and moving-coil instruments. Tables of dimensions and diagrams for mounting are also provided. Amongst moving-coil instruments we notice the "Sector" and "Edgewise" patterns; the former can be provided either to mount direct on the switchboard, or on brackets when required to revolve, or for fixing at end of slate. The Edgewise pattern is provided with the usual bracket for moving in a vertical plane, but can also be fitted on the top of the switchboard. "Ediswan" separate shunts for ammeters also milliampere and millivolt meters, built on the moving cell principle, Cardew voltmeters, cell-testing instruments for small readings, and portable instruments for large readings, lamp-testing ammeters, detectors, galvanometers, &c. Section V. is devoted entirely to wires and cables, which are listed in large variety, in vulcanised and pure rubber, lead-covered, armoured, concentric, and many other patterns. Flexible cords receive special attention; they include flexibles for dynamos and switchboards, motor-cars, ships, bells, telephones, &c., and some very useful pages are added for fuse, binding, and resistance wires. The introduction comprises some useful information on joint-making, a table for calculating fall of potential, and a wiring table for "Royal" lamps. These sections are now being circulated among the trade, and buyers of such goods who do not receive copies should drop a card to the company at Queen Street, EC.

The St. Helens Cable Co., Ltd., which, we understand, has obtained very satisfactory results from the past year's experience under the reorganised arrangements, has just issued a booklet of some 48 pp. descriptive of their "Dialite" cables, which are being widely used for electric lighting purposes. The book has been brought out for the purpose of telling exactly what "Dialite" cables are, and it contains particulars of various tests, as well as copies of testimonials, and a list of towns for which such cables have been supplied. It further contains other information which the company has hitherto only had in separate manuscript form, but which may prove of interest to those concerning themselves with the use of electric light cables. Among the pictures in the book are some photographic views of the company's cotton and silk-covering strip, the power house, a longitudinal machine, a stranding machine in the main cable shop, also the dry-core shop.

A copy of the ninth edition of the illustrated price list of the Universal Electric Supply Co., of C.-on-M., Manchester, is before us. It details a large variety of bells, batteries, terminals, medical coils, small electric motors and dynamos, model tramways, electric lighting accessories, and sundries.

Pamphlet No. 172 of the British Thomson-Houston Co.'s series contains an illustrated description of the ondograph.

Gradon v. Fleck.—At Newcastle County Court on the 24th ult., his Honour Judge Greenwell heard an action in which Thompson Gradon, jun., carrying on business as an electrician in Barras Bridge, Newcastle, made a claim for £25 against William Cuthbertson Fleck, builder, Newcastle and Gosforth, being the balance of an account for an electric light installation in the Bigg Market premises belonging to Mr. Robert White, wholesale jeweller.

Mr. Meynell (for the plaintiff) said (according to a report of the case in the *Newcastle Chronicle*), that defendant was engaged to build certain premises in the Bigg Market for Mr. Robert White, in 1902. Messrs. Mould & Tasker were the architects for Mr. White. In January, 1903, the architects asked the plaintiff to tender for the electric lighting work in connection with the building, and the plaintiff tendered, his tender being £55, which was accepted. Plaintiff did the work, and there was no complaint made about how it had been executed. When he applied for payment the architects said they had ordered the work as agents for the builder. A dispute had arisen between the builder and the architects about the quality of some of the building work; in fact, the building was falling, but this had nothing to do with the work that the plaintiff had done. As a consequence, Mr. White had refused to pay, and the architects had refused to certify for more than 90 per cent. of the contract price. Plaintiff subsequently received £30, under a special certificate from the architects. Their remedy was against Mr. Fleck, under the terms of the contract. The position was this: Plaintiff got his orders from the architects; the architects said they acted as agents for Mr. Fleck. The plaintiff sued Mr. Fleck, and must prove the architects' authority to give orders on behalf of Mr. Fleck. That, he submitted, was proved by clause 20 of the contract.

Mr. Mundahl, for the defence, submitted that the architects never directed the defendant to pay anything else but the £30 that had been paid. The defendant had paid over to the plaintiff all the money he had ever received in respect of this matter. Mr. Mundahl quoted parallel cases to show that the building owner was the person liable where a contractor had taken no steps to make himself personally liable, or had not made any contract with a specialist.

His Honour reserved judgement.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., have secured the following contracts:—

Auckland Electric Tramways Co.—Seven complete electric tramcars.
Paisley Tramways (per Mr. W. M. Murphy).—Five single trucks.

Copper.—Messrs. Merton's August statistics relating to copper show a moderate increase in the visible supply, the total at the end of the month being 13,415 tons as compared with 12,282 a fortnight earlier, and 12,867 tons at the end of July. Actual stocks amount to 6,990 tons as against 6,117 tons on July 31st, and total supplies reached 29,895 tons as compared with July's 28,339 tons, American shipments being on a larger scale than for five months past; while the receipts from other quarters were quite normal. Deliveries continued to increase as a result of the better consumptive demand, and amounted to 29,347 tons for the month, being greater than for any month since April last.

Wages in the Engineering Trade.—Notice has been received by Mr. Ratcliffe, the north-east coast organising delegate of the Amalgamated Society of Engineers, from Mr. Robinson, the Employers' Federation secretary, giving two months' notice of a reduction of 2s. per week on time and 5 per cent. on piece rates, to take effect on the first full pay after October 22nd. The standard wage at present is 35s. per week. Over a year ago the engineers of the north-east coast suffered a reduction of 1s. per week, and in the spring of this year the employers gave notice of a reduction of 2s. per week and 5 per cent. on piece work. The men put in a counter demand for 2s. per week advance, and after futile conferences at York and in London the wages question was allowed to fall into abeyance. Now by the further notice for a reduction the employers have raised the whole question.—The *Times*.

Imports of Foreign Electrical Apparatus. — The value of the foreign electrical goods and apparatus imported into this country during July last is returned at £50,401, bringing up the total for the first seven months of the year to £434,499, as compared with £421,400 in the first seven months of last year.

Annual Holidays.—Messrs. Holden & Brooke, Ltd., of Sirius Works, West Gorton, Manchester, announce that their works are to be closed from September 5th to 10th, inclusive, for the annual holidays.

Smoke Nuisance Prosecution.—The City of London Electric Lighting Co., Ltd., were fined £10 and costs the other day for allowing black smoke to escape from one of their chimney shafts in such volume as to be a nuisance. The magistrate was assured that no pains were spared on the company's premises to comply with the requirements of the law; and his worship is going to pay a visit to the works, and see for himself what the company are doing

Horsfall Destructors. — In May last the Horsfall Destructor Co., Ltd., received a telegraphic order for a complete destructor plant for the city of Lorenzo Marques, Delagoa Bay, eight weeks being allowed for the delivery of the plant, which included destructor cells, dust catcher, steel buildings, steel chimney, boiler, &c. We understand that the whole plant was placed on board one steamer at Liverpool within the specified time, and is now in process of erection at Delagoa Bay. The Horsfall Co. has also recently received new orders for destructors for Kingstown (Co. Dublin), and for Ilkley, Windsor, Luton, Bromley, Chiswick, Bridport, Gorton, and Leigh. Horsfall destructors have been recently completed and put into operation at Cairo, Zurich, Folkestone, Swansea, and Stourbridge.

Dissolutions and Liquidations.—The Pioneer Electric Co., Ltd., is winding up voluntarily with Messrs. J. F. Albright and R. Dand, of 66, Victoria Street, S.W., as liquidators.

Creditors of the Electric Extension Co., Ltd., must send particulars of their debts, &c., to the liquidator, Mr. C. E. Ruckley, 12, St. John's Lane, Liverpool, by October 1st.

The "Lancashire" Patent Belting and Hose Co. is winding up voluntarily with Mr. Thomas Pilling, 30, Brown Street, Manchester, as liquidator.

Electrical Illuminations.—The *Brooklyn Edison* is a monthly publication issued by the Edison Electric Illuminating Co., of Brooklyn. The August issue is full of charming examples of electrical illumination effects at Coney Island, where Dreamland and Luna Park are most lavishly illuminated and decorated at night-time, affording a most attractive display. The Dreamland tower, the great white entrance to, and the night scene in, Dreamland, also the views from the water, are fascinatingly beautiful. It is stated that in Dreamland there are more incandescent lamps lit than are found in many cities of considerable size, and as many as were utilised in the whole of Coney Island last year. The supply, it need hardly be added, is taken from the system of the Edison Electric Illuminating Co., that being considered a better arrangement than an isolated plant could afford.

Bankruptcy Proceedings.—A meeting of the creditors of James Wm. Hunter and Albert Clapham, trading at 101, Kirkstall Road, Leeds, as the Yorkshire Motor Car and Electrical Engineering Co., was held on Friday, when accounts were presented showing liabilities amounting to £3,415, assets valued at £2,047, and a deficiency of £1,367 14s. Mr. W. H. Platts was appointed trustee with a committee of inspection.

New Arc Lamp Coupling.—Mr. G. Braulik, of Upper Thames Street, London, has introduced an ingenious arc lamp coupling. In this device the lamp is hung on to a carrying plug, which in turn is hung from the suspension rope. The carrying plug is drawn up into a socket, in which is arranged a coupling cup consisting of small hinged pieces, which normally support the carrying plug. To release the lamp, it is only necessary to haul up slightly the lamp and carrying plug, when the latter forces open the coupling cup, and allows of the lamp and plug being lowered clear of the socket. In its descent, the carrying plug adjusts the coupling in readiness for supporting the lamp when the latter is again hauled up.

Plant for Sale.—The Sunderland Corporation is offering some Willans-Holmes steam dynamos, Crompton single-phase alternators, and a number of transformers for sale. For particulars, see our advertisement pages to-day.

Annual Outings.—Last Saturday the employés of Messrs. Stegmann & Co., of Clapham Junction, to the number of about 30, went for their annual outing to Brighton. After luncheon at the "Queens," the remainder of the day was occupied with various excursions.

On Saturday last the employés of the electrical departments of the Sir Hiram Maxim Electrical and Engineering Co., Ltd., went for their annual outing to Clacton-on-Sea. All did justice to Sir Hiram Maxim's invitation to partake of dinner served at the North Avenue Restaurant. Tea was provided by the kindness of the directors of the company. Mr. A. W. Hill, the works manager, in presiding, said that the fact that they were gathered there in greater numbers than they had ever been before spoke for itself of the appreciation shown by the electrical profession for their various manufactures.

Book Notices. — "Science Abstracts." Section A, Physics; Section B, Electrical Engineering. Vol. VII. London: E. & F. N. Spon, Ltd. 1s. 6d. each.

"Transactions of the Institution of Civil Engineers of Ireland." Vol. 30. Dublin: John Falconer.

"Modern Electric Practice." Vol. IV. By Magnus Maclean. London: The Gresham Publishing Co.

"The University of Leeds: Prospectus of Classes and Regulation for Degrees in Arts and Science, and Regulations as to Admission of Students, &c." Session 1904-5.

"Etude sur les Résonances dans les réseaux de distribution par courants alternatifs." By G. Chevrier. Paris: L'Eclairage Electrique.

"Atti della Associazione Elettrotecnica Italiana." Maggio-Giugno, 1904. Rome: Sede Centrale, 397, Corso Umberto I.

"Electric Smelting and Refining." By Dr. W. Borchers. Translated from the third German edition, with additions, by W. G. McMillan. Second English edition. London: Chas. Griffin & Co., Ltd. 21s. net.

"Entwurf und Konstruktion Moderner Elektrischer Maschinen." By Ernst Schulz. Hanover: Gebrüder Jänecke. M. 7.50.

LIGHTING AND POWER NOTES.

Aberdeen.—At a recent meeting of the Gas and Electric Lighting Committee of the Aberdeen T.C., it was resolved to recommend that the charge for electric light be reduced by one halfpenny per B. of T. unit.

Barnsley.—A L.G.B. inquiry was held recently into the application of the Corporation to borrow the sum of £6,868 for extensions of plant, mains, and street lighting. The amount borrowed by the Corporation for electricity purposes to date is £51,228, and under the present loan it proposes to erect an additional 56 arc lamps for street lighting.

Barton.—The R.D.C. has decided not to assent to the application of the Lancashire Electric Power Co. for a prov. order to supply current in the Council's district, it being anticipated that better terms can be obtained from neighbouring local authorities who have obtained orders.

Batley.—The Corporation has decided to reduce the price of energy from October 1st, for the second and subsequent hours per day, from 3d. to 2d. per unit.

Bolton.—The Corporation Electricity Committee has adopted the following scale of charges for energy supplied to cotton mills, &c.:—Consumers using 500,000 units and upwards per annum, 10 per cent. off ordinary charges: consumers of 750,000 units, 12½ per cent. off; 1,000,000 units, 15 per cent. off; 1,250,000 units, 17½ per cent. off; 1,500,000 units, 20 per cent. off.

Castleford.—The B. of T. has informed the U.D.C. that it is not prepared to extend the E.L. order, but intimates that a fresh application might be made about November 6th, when the order expires.

Clonmel.—The Joint Committee of Management of the asylum has called for tenders from expert electrical engineers, to make an examination of the institution, with a view to scheme of electric lighting, the fee not to exceed £10 10s.

Continental Notes.—Switzerland.—An international convention for the regulation of electric power is now being negotiated between Switzerland and Germany. The agreement refers to the utilisation of the Rhine at Lanfenburg, and the project contemplates the generation of electrical energy to the extent of 50,000 H.P.

Germany.—A central electric lighting station is about to be established in the town of Furstenfeld.

Italy.—La Societa per la Ferrovia Elettrico di Valle Brembana has applied for a concession to put down a plant to utilise the water-power of the River Brembo at San Gallo in the generation of electrical energy for lighting and power purposes.

Darlington.—The T.C. has decided to supply energy at 3¾d. per unit to consumers of not less than 20,000 units per annum for lighting purposes.

Davyhulme.—For the supply of current to this district, the local authority has declined an offer by the Lancashire Electric Power Co., being of opinion that more satisfactory terms can be obtained from neighbouring authorities (Manchester or Salford) than from a private company.

Heckmondwike.—A new Willans-Dick, Kerr lighting set of 330 KW. has just been installed at the Council's electricity works.

India.—Messrs. Burn & Co., of Howrah and Calcutta, have installed an electric plant at the Kankinarrah Jute Mills for lighting and power purposes, consisting of three sets of Belliss engines, each of 50 H.P., direct coupled to Clayton generators. The switchboard is arranged to run all three sets in parallel for lighting purposes or to use one set for power purposes only. The same firm has recently put down a lighting and power installation for the military department at Fort Attock, N.W.F., the electric lighting of the Burmah Railway shops at Insein, a power installation at the Howrah Saw Mills, &c. Messrs. Burn & Co., of Calcutta, have also applied to the Government of Madras for license to supply electrical energy throughout the municipal area. It is proposed to erect works and supply electricity by underground or aerial mains, whichever may be approved by the Local Government. The license is to run for 42 years, at the end of which time the Government can exercise the right to purchase. Messrs. Crompton & Co. are already in the field, but the terms of Messrs. Burn's proposal appear more favourable.

Llanelly.—At a recent meeting of the U.D.C., the agreement with the British Insulated and Helsby Cables, Ltd., was further considered. The company stated that they could not see the deputation appointed by the Council, pending an appeal which they proposed to make against the judgement of the High Court in the present action with the Tramway Co. A communication had been received from the B. of T. asking what steps had been taken to carry out the electric lighting order.

Leeds.—The Corporation Lighting Committee has resolved to light all the tramway routes in the city by electric arc lamps, for a mile from the junction of Briggate and Boar Lane.

Llantrisant.—The U.D.C. has informed Mr. G. Vaughan Fowler that it would offer no opposition to the proposed application for a prov. order for E.L. in the district, provided that the position of the Council was not in any way compromised.

London.—Poplar.—The B.C. has received applications for the supply of energy at Hackney Wick totalling about 35 KW., and has decided to lay a feeder and distributing main to supply this area at an estimated cost of £1,400.

Melbourne.—The City Council has authorised the borrowing of £25,000, the balance of £75,000 which the Electric Supply Committee are entitled to borrow, for the carrying out of additional works in connection with the Council's scheme of electricity supply.

New Zealand.—The Hawera B.C. has accepted the local electric light company's tender of £2 3s. 9d. per 40-c.p. lamp for street lighting for five years; the lamps to be lit from sunset until 11 p.m.

New Plymouth.—The Council has agreed to the terms of the Brush Electrical Engineering Co., of Sydney, for installing the electric light into the town, and the estimated cost is £5,200. Water power is to be utilised for generating purposes, and will be conveyed a distance of about four miles to the power house. Alternating current machines of 67 h.p. and 2,200 volts coupled to Gilkes double vortex turbines are to be put down. The energy is to be conveyed to a distributing station by bare copper conductors, and there transformed down to a pressure of 200 volts for street and private lighting.—*Australasian Hardware.*

Oldbury.—The U.D.C. has agreed to transfer its E.L. order to the British Electric Traction Co., upon condition that the company pay the Council 5 per cent. upon the gross receipts, and also that they construct a tramway from Blackheath to Oldbury.

Ormskirk.—The U.D.C. has rescinded the minute approving of the draft agreement of the Council with the National Electric Power Supply Co.

Paris.—The various districts of Paris have, for electric lighting purposes, been divided up into sections, and each section has been specially conceded by the Municipality, to a different company. The concessions which these companies hold begin to expire in 1907, and the Municipality is by no means disposed to renew the concessions on the old terms, there being a strong tendency towards municipalisation.

A technical and scientific committee has now been appointed to study the question and to advise the Council. The question of the City taking over the electric lighting concessions is somewhat complicated. The various conduits made by the electric companies to carry their cables become, by the terms of the agreement, the property of the City at the expiration of the present concessions. There are 628 kilometres of such conduits and canalisations. On the other hand, the City Administration is not obliged to purchase the generating stations and sub-stations now the property of the companies, neither are the companies obliged to sell. The connecting branch wires to each consumer remain the property of the companies.

The question is a difficult one to settle, for the conduits and canalisations would be of no use to the City without the generating and power stations and the branch connections. Neither could the companies continue to exploit their concessions without the City conduits and canalisations, for it is certain that permission to open up fresh conduits would be refused. Unless the City is prepared to spend a large sum in building new generating stations and in fitting up new branch connections, the matter will probably end in a compromise.

Prestwich.—For the purpose of electrically lighting the district of Prestwich (under the Prestwich Lighting Order of 1900), the Salford Corporation is seeking power to borrow a sum of £5,000. By a preliminary order, Manchester obtained power to supply electricity to Prestwich, but in May, 1903, the order was transferred to Salford, with an obligation attached that it should be carried into effect within two years. In order to do this, station buildings had to be erected and mains laid; and it is to meet the cost of these that a loan of £5,000 is now asked for. At the L.G.B. inquiry last week no opposition was offered.

Queensland.—According to a contemporary, an electrical plant has been installed at the Moreton Central Sugar Mill, Nambour, and the question of lighting the town by electricity from the mill, is under consideration.

Redcar.—The B. of T. has written to the U.D.C., inquiring whether it proposes to take any immediate steps to carry out the obligations under the E.L. order obtained in 1900. At a meeting of the Council on September 1st, the chairman said that the income likely to be derived from private consumers was still under investigation.

Redruth.—The Urban Electric Supply Co. is rapidly extending its operations. The number of consumers of electric light has steadily increased, there being now between 500 and 600, representing the equivalent of 28,444 8-c.p. lamps, and Redruth streets are lit with 172 incandescent and two arc lamps. 220 h.p. of motors has also been installed for driving machinery.

Sowerby.—The Parish Council has decided to accept the tender of the Northern Counties Electric Supply Association for lighting the public lamps, the price to be 28s. 6d. per lamp for 1,385 hours, with an approximate 40 c.p. The Thirsk Gas Co.'s tender was 29s. per lamp for the same number of hours, and it offered to fit 20 of the lamps with incandescent burners.

Sunderland.—On the recommendation of its electrical engineer, the Lighting Committee has resolved, subject to approval by the T.C., to install at the sub-station at Pallion an additional three-phase machine, at an estimated cost of £3,000, to cope with the increased demand for energy.

Sydney.—The municipal electric supply was inaugurated on July 25th last. The area lighted is from Circular Quay to the Redfern railway station, and in the opposite direction from Hyde Park to portions of Darling Harbour. The energy was switched on to over 200 public lamps. The work of erecting the second engine was concluded during last week, when satisfactory tests were made. The remaining areas, viz., the William Street and George Street West blocks, were expected to be lit about August 20th.

Willenhall.—The U.D.C. has given notice to the Midland Electric Corporation for Power Distribution, requesting it to lay down distributing mains for the purpose of a general supply throughout the whole of the streets in the Council's area, and, if necessary, to enter into an agreement with the Corporation for the supply of electricity for street lighting for a term of three years.

Windsor.—Damage amounting to nearly £3,000 was caused by a fire at the electric light works on September 2nd.

Wisbech.—A L.G.B. inquiry was held on Tuesday relative to the application of the T.C. for a loan of £25,000 for E.L. purposes. There was a considerable amount of opposition.

Wrexham.—At the quarterly meeting of the T.C. on Tuesday, a report of a sub-committee, proposing an extension of the electric supply plant, came up, and after discussion, was adopted.

TRAMWAY AND RAILWAY NOTES.

Belfast.—The following is the approximate estimate for the conversion of the Belfast tramway system from horse traction to electric traction:—Relaying permanent way, £412,456; bonding, £7,785; overhead equipage for 41 miles 2 furlongs 2·34 chains, at £1,350 per mile, £55,730; distribution system, £54,000; extension of distributing station, £85,000; 200 cars, £135,000; car-sheds, shops, £46,000—total, £827,000.

Birkdale.—The U.D.C. has informed the Southport T.C. that it does not intend to sell its tramway undertaking, which has been leased to the Southport Tramways Co., Ltd.

Bury and Manchester.—The tramway line from Whitefield Railway Station to the Bury boundary is now finished. Very shortly the Salford cars, which now run through Prestwich to the Whitefield Railway Station, will run over it, meeting the Bury cars at the boundary. Direct communication between Manchester and Bury, by electric car, will thus be established.

Fife.—The extension of Kirkcaldy to the neighbouring burgh of Dysart is expected to take place shortly, and, in conjunction with the extension, there is the further prospect, through the enterprise of Mr. Wemyss, of Wemyss Castle, of a line of tramway being laid through the Wemyss estate, and eventually passing *vid* Buckhaven and Methil, all the way to Leven. This system would also connect with the Kirkcaldy tramway.

Glasgow.—Lord Balfour of Burleigh, late Secretary for Scotland, has been appointed by the Board of Trade, referee in the dispute between the Glasgow Corporation Tramways and the Paisley District Tramways Co. as to running powers by the former's cars over the latter's system to Paisley Cross.

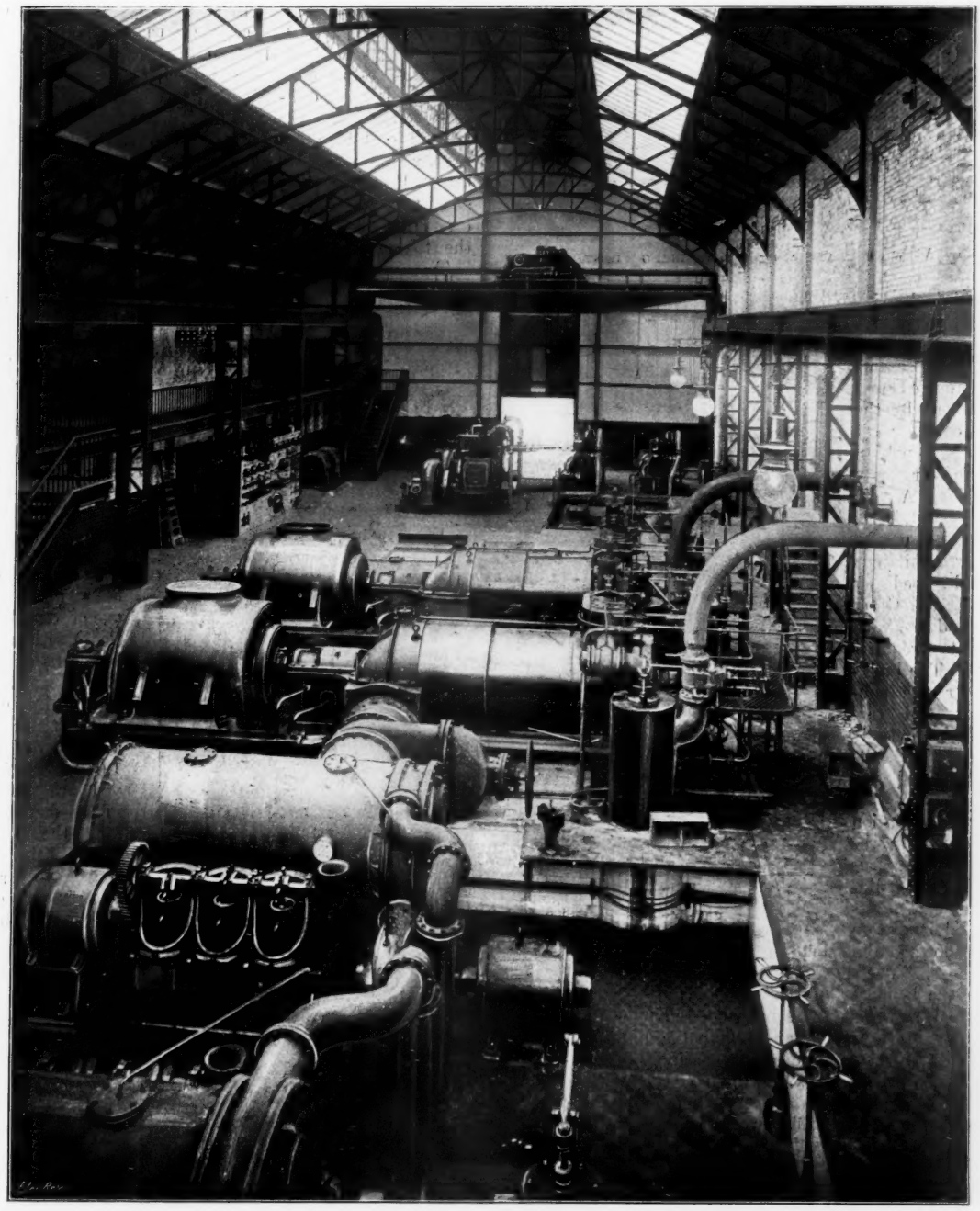
Heywood.—The difficulty which has existed for some time with reference to the tramways here, has not yet been solved. Last week representatives of the Tramway Committees of Heywood, Bury, and Rochdale met to consider further proposals for the working of the Heywood lines. The Heywood Council suggests a 21 years' lease of the lines within the borough, whilst the neighbouring authorities want a 30 years' lease. There are also differences as to which authority is to supply the energy for working the lines. Another conference is to be held.

Italy.—Writing to the *Gazette de Frankfort*, a Milan correspondent states:—The employment of electric traction on the Monza-Milan line, which formed the first experiment of the kind on an established European railway, has been definitely abandoned, the new system not having fulfilled the expectations of the authorities, more particularly from a financial point of view. On the line in question, as well as on the Poggio-Rusco-Bologna section, the employment of accumulator traction has not given good results, and to-day there are only two important railways in Italy on which electric traction is employed—that of Milan-Gallarate-Varese-Porto Ceresio (Lake of Lugano), on which the Thomson-Houston continuous current system with third-rail is being adopted. It is proposed to extend this line, in course of time, as far as Lugano. The other line, on which a high-tension alternating current system is employed, runs from Lecco, on Lake Como, to Collico, where it divides into two sections, one running to Chiovenna and the other to Sondrio. In regard to the two last-named lines, it is stated that the working will prove satisfactory from a technical point of view, but it is doubted, in view of the high first cost, whether it will prove remunerative from a financial aspect. In addition to the foregoing, there is a tramway about 10 miles long between Milan and Monza, which is worked by the Edison Co.

(*Continued on page* 423.)

NORTH METROPOLITAN ELECTRIC POWER SUPPLY AND TRAMWAYS.

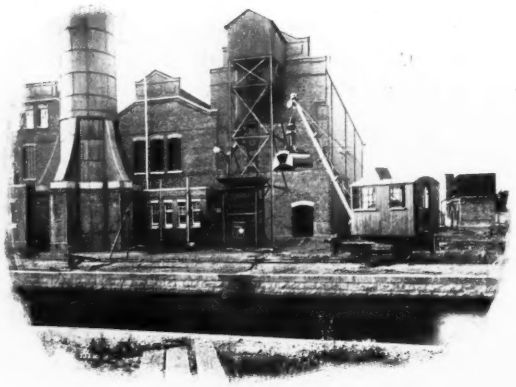
We recently referred at some length (Electrical Review, July 29th) to the opening of the first section of the Metropolitan Electric Tramways, which took place on 22nd ult., and to the simultaneous inauguration of the main power station of the North Metropolitan Electric Power Supply Co. at Brimsdown. The situation of these two undertakings, which are practically under the same control, and the favourable prospects which lie before them, endue them with more than the ordinary degree of importance, and we are, therefore, very pleased to be enabled, by the courtesy of the respective companies, to place before our readers further details of both systems, with photographs of the plant and tramways. As announced in a recent issue, a further section of electric tramways, laid down by the Middlesex C.C., and leased by the Council to the Metropolitan Electric Tramways, was opened for public traffic on August 20th, and doubtless we shall hear of many more additions to the network of routes in operation as successive portions are electrically equipped and completed. Another two miles of the company's tramways was opened in Tottenham on the 24th ult.



Brimsdown Power Station: General View.

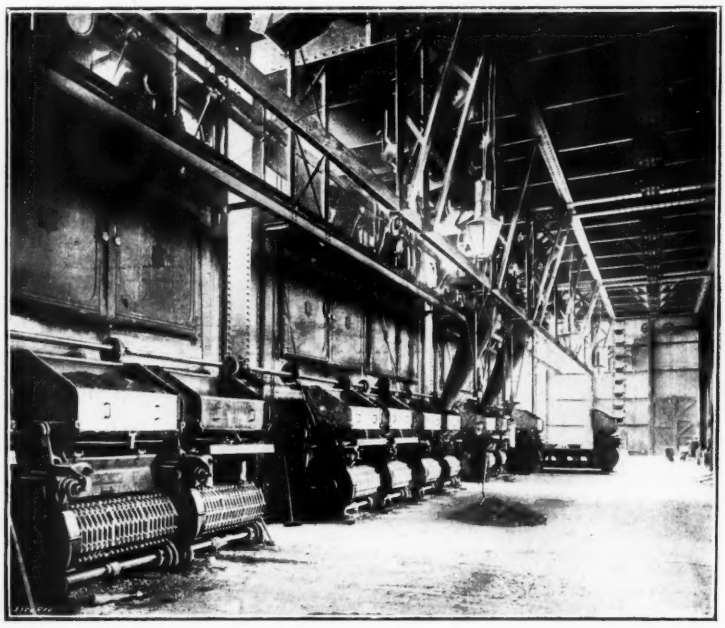
We shall first describe the generating station at Brimsdown, an installation of exceptional interest, as in its design are embodied the most advanced ideas of the day in respect

of the generators, switchgear, and system of distribution. As the power house, sub-station, and distributing system



View of Crane and Coal-handling Plant.

was originally intended solely for the tramway system, the scheme was prepared and carried out by the chief engineer of the Metropolitan Electric Tramway Co., Mr. A. H. Pott, M.I.E.E., while the power-house buildings were designed by Mr. C. W. Gray, in accordance with Mr. Pott's requirements. The buildings for the sub-stations and car-sheds, were entirely designed by the engineer and his staff.



Range of Boilers showing Coal-weighing Apparatus.

The power station is situated in the open country, about 3 miles from Enfield, and 2½ miles from Edmonton, on a site allowing abundant space for future extensions. The River Lea navigation forms the boundary of the site on the east, and serves at the same time as a waterway for the conveyance of coal to the works, and as a source of condensing water. A private dock has been constructed to facilitate the delivery of coal and other materials, sufficiently large to accommodate two barges. The buildings are constructed of steel and brickwork, with good lighting from the roof and end walls, and are of sufficient dimensions to accommodate considerable additions to the plant already installed; arc lamps are provided for lighting at night. The general contractors for the execution of the work were the Brush Electrical Engineering Co., Ltd., with Mr. Clift Ford, of Willesden, as sub-contractor for the buildings; the structural iron and steel work was supplied by Messrs. Dorman, Long & Co., Ltd., of Middlesbrough.

Exterior of Works at Brimsdown.

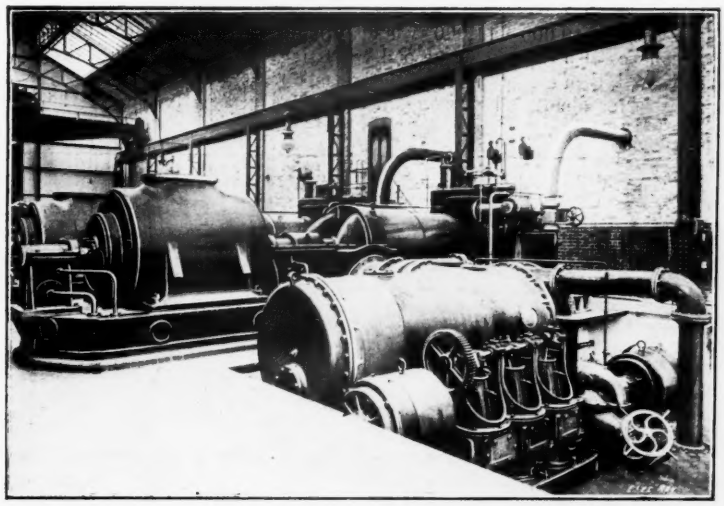
One end of the building is closed with galvanised iron for the present, pending extensions, and the outer side of the boiler house is similarly constructed. The chimney stack is of steel, and was built by Messrs. Piggott & Co., Ltd., of London and Birmingham. It is 125 ft. in height from the top of the brick pedestal, and 160 ft. from the ground level. The shaft is lined throughout with firebrick, carried on angle irons riveted to the shell at intervals of 15 ft. As will be gathered from our view of the exterior, the station buildings have a handsome appearance, the steel shaft being by no means ungraceful.

A travelling electric crane, made by Messrs. Smith and Sons, of Rodley, near Leeds, with Siemens Bros.' electrical equipment, and fitted with a grab of 15 cwt. capacity, runs on rails along the edge of the dock, and is used for discharging coal from the barges. The crane is slewed so as to bring the loaded grab over the hopper of an Ingrey coal-weighing machine, into which the coal is delivered. The machine indicates the weight of each load of coal by a pointer upon a dial, and integrates the total, which is shown on a second dial of the cyclometer type. From the weighing hopper the coal passes through a shoot to a coal-filler beneath the floor level, and is thence carried by a bucket chain conveyor to the coal bunkers over the stoking floor in the boiler house.

The conveyor was supplied by Messrs. Babcock and Wilcox, Ltd., and is capable of handling 45 tons per hour; it is driven by a B.T.H. motor of 6 H.P. It passes over the bunkers and returns beneath the stoking floor, being used also to remove the ashes. An ash hopper is provided outside the end of the boiler house (as shown in one of our illustrations) with a shoot by means of which the ashes may be discharged into carts.

The bunkers have a capacity of about 1,000 tons of coal, and are arranged in a double line over the stoking floor, being designed to provide also for a second range of boilers when extensions are carried out. The large storage capacity mentioned is necessary, on account of the fact that occasionally, after a spell of wet weather, the canal becomes

flooded, and the delivery of coal in barges is interrupted; a rise of only a foot or so is sufficient to bring about this result, as certain bridges over the canal are too low, and the authorities responsible appear to be indisposed to raise them. The line of bunkers nearest to the existing boilers is provided with measuring shoots, delivering the coal direct into the firing hoppers, but the second line of bins is merely provided with sliding doors where the shoots will eventually be fixed, and the coal can thus be dropped on the stoking floor in case of need, and pitched into the hoppers by hand.

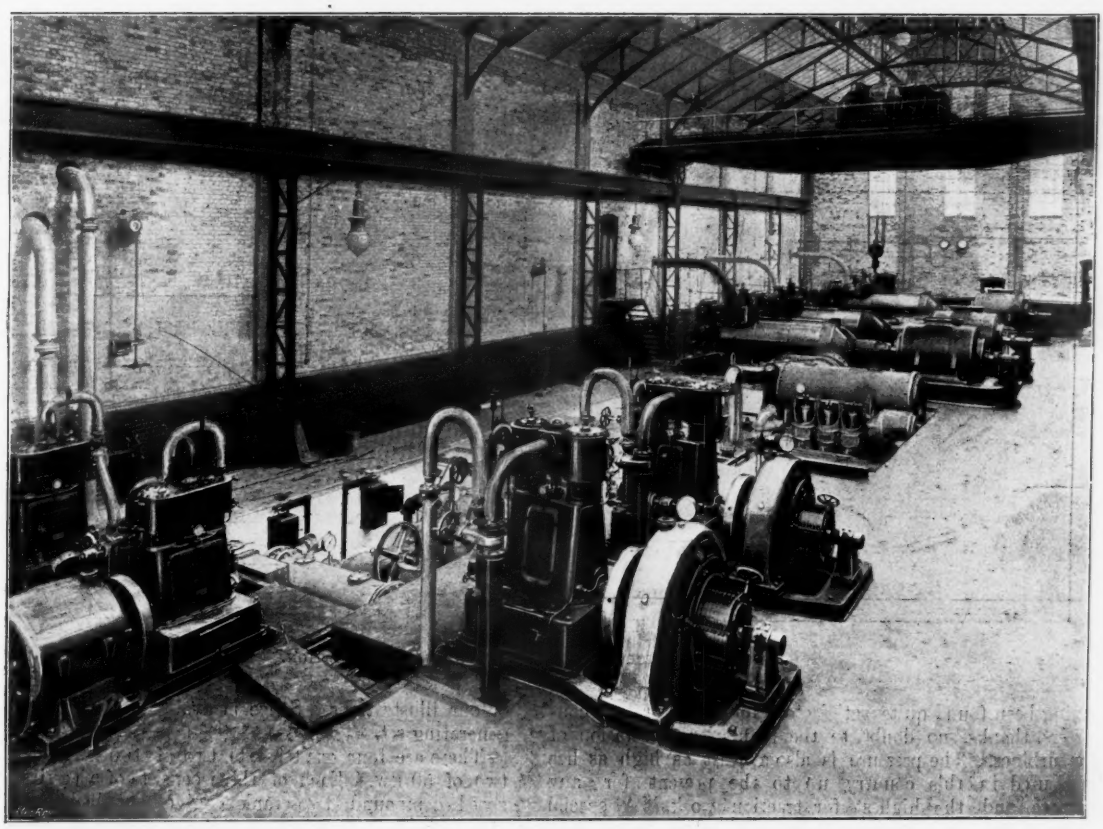


View of Turbo-alternator and Condensing Plant.

We give a view of the range of boilers, which also shows the coal-weighing apparatus. There are two of these, of the Ingrey pattern aforementioned, running along rails in front of the boilers. In using these, the coal is first admitted into the measuring shoots already referred to, and is then dropped into the weighing hoppers; the weight is indicated on a dial, and is also added to the tale of previous charges on a second dial, after which the coal is shot into the hopper of the mechanical stoker. These weighing machines are driven by a flying rope, actuated by a B.T.H. motor at the end of the boiler house, which also supplies motive power to the weighing apparatus outside the building, by chain gear.

There are at present six Babcock boilers installed, with room for two more; each of these is fitted with the same firm's chain grate stokers and internal superheaters, and is capable of evaporating 15,000 lbs. of water per hour, the steam being superheated 150° F. The stokers are driven by one or other of two 15-H.P. motors, one at each end of the line of shafting. The boilers are arranged with Mr. W. H. Miller's patent setting.

The feed and oil cooling water is derived from a surface well, 20 ft. deep, from which it is lifted by two Hayward-Tyler pumps to a storage tank, shown in one of our views, which has a capacity of 33,000 gallons. The pumps are situated in a chamber beneath the tank, and are driven by B.T.H. motors of 1 H.P. We may here mention that the foundation of the site consists of hard gravel, heavily waterlogged, and consequently all the basements of the station have been lined with Callender's bitumen sheeting. The boiler feed pumps were supplied by Messrs. J. P. Hall & Co., Ltd., of Peterborough, and are three in number, each capable of delivering 4,000 gallons of water per hour. There are no economisers, the feed heated to 130° F. approx. being derived from the hot-well and drains. The main steam range is of simple character, consisting of a single equalising header, with branches to the boilers and turbines. It was

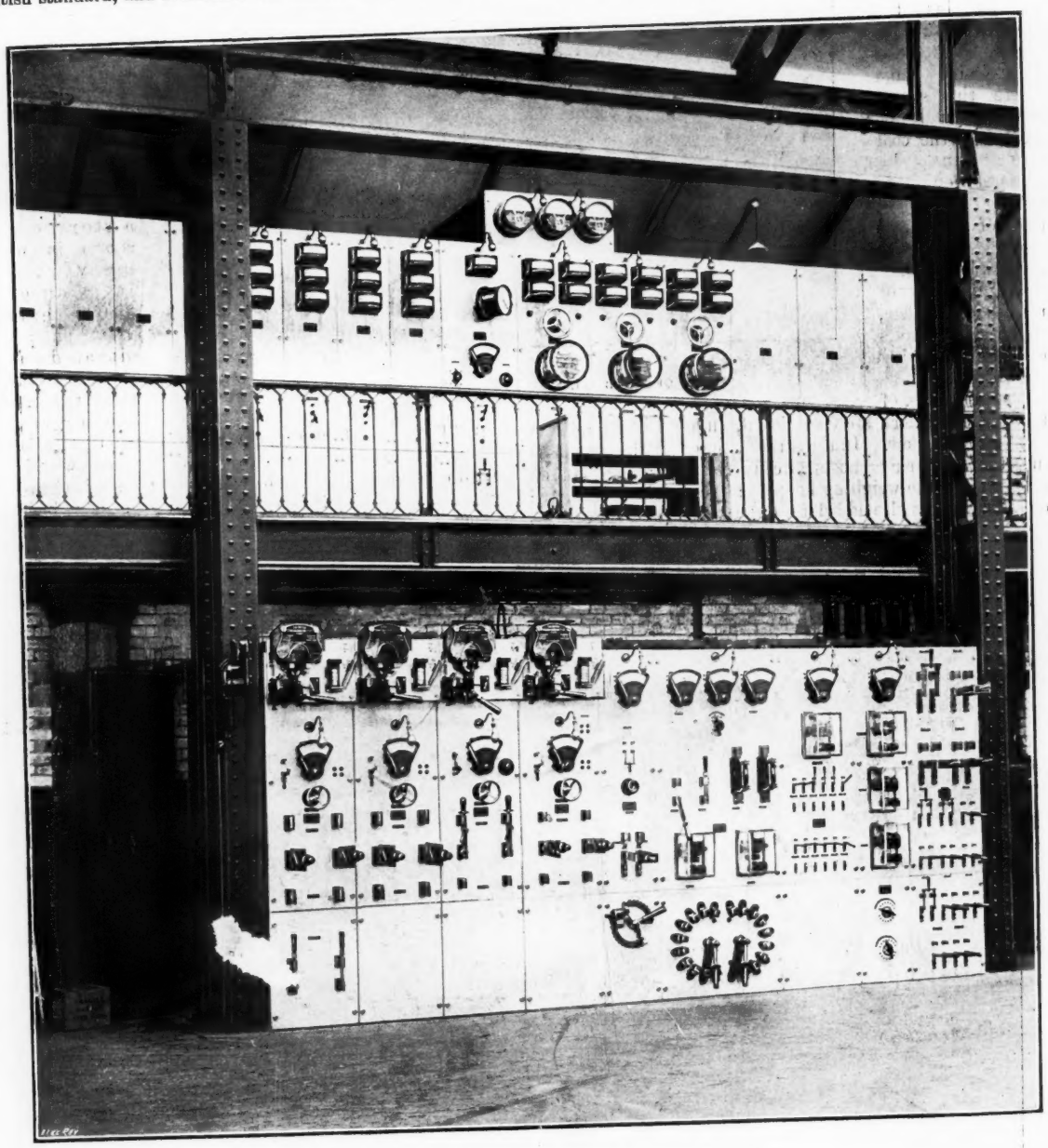


General View of Interior of Engine Room, Showing Exciters.

supplied and erected by Messrs. John Spencer, Ltd., of Wednesbury.

The main generating plant comprises three turbo-alternators of 1,000 KW. each, the turbines being made by Messrs. C. A. Parsons & Co., of Newcastle-on-Tyne, and the alternators by Messrs. Brown, Boveri & Co., of Baden. The generators are of the three-phase type, and run at 1,500 r.p.m., at a working pressure of 10,000—11,000 volts between terminals, and a frequency of 50 cycles per second. The frequency, it will be observed, is in conformity with the British standard, and is suitable for almost all purposes, it having been found quite satisfactory for driving rotary converters, thanks, no doubt, to the regularity of rotation of the turbines. The pressure is also at least as high as has been used in this country up to the present for any purpose, and the highest for traction work. A special feature of the generators is the exceptionally adequate provision for ventilation. Cold air from the outside of the building is led into the bedplates, whence it is discharged through a hollow in the stator to an outlet at the top of the generator frame, forming quite a powerful blast. The result is that these generators run remarkably cool at any load. The exciter slip rings are mounted on the main shaft, one at each end of the machine, the alternators being of the rotating field-magnet type. The exhaust steam is disposed of by separate condensing sets supplied by the Mirrlees, Watson Co., Ltd., of Glasgow, each of which is capable of dealing with 25,000 lbs. of steam per hour. Blake & Knowles automatic atmospheric valves are fitted on the exhaust pipes, providing an alternative exhaust to atmosphere through a common exhaust pipe of wrought-iron, with an up-take at the end of the building. The air pumps are of the three-throw Edwards type, and the circulating pumps of the centrifugal pattern, driven by Brush motors.

The general lay-out of the plant is well shown in two of our illustrations. Space is available for a fourth large generating set.



The Main Switchboards at Brimsdown Power Station.

There are four exciter sets, two of 100 KW. output, and two of 50 KW. Each of these consists of a vertical high-speed compound two-crank engine, supplied by Messrs. Belliss & Morcom, and a generator supplied by the British Thomson-Houston Co., Ltd., of Rugby. The exciting pressure is 110 volts, but the pressure can be raised to 125 volts. A 25-KW. motor-driven booster, made by The British Thomson-Houston Co., is provided for charging the storage battery, which consists of 63 35-plate Pollak cells, having a capacity of 900 ampere-hours at the three-hour discharge rate. Separate condensing plant in duplicate is provided for the exciters, of the Mirrlees, Watson Co.'s make, with British

Thomson-Houston motors; each set is capable of condensing 6,000 lbs. of steam per hour. As the condensed steam is in this instance greasy, it is thrown away.

The engine room is served by a 25-ton electric travelling crane, built by Messrs. Carrick & Ritchie, and driven by a single 10-H.P. motor.

The switchgear is in two portions, the direct-current exciting station lighting and power board being on the ground floor, and the main switchboard on a gallery above the former. The D.C. board calls for no detailed description beyond mentioning that there are separate bus-bars for exciting and for power supply. The main switchboard is of the remote control type, the high pressure switches being enclosed in brickwork compartments at a distance from the operating board. The latter comprises 15 marble panels, of which 7 are as yet unoccupied. Provision is made for controlling four feeders and the three generators, with a general station panel. The feeder panels are each equipped with three ammeters, one on each phase, and the small, almost insignificant, throw-over switch which controls the motor operating the main switch. The station panel carries an exciter voltmeter, bus-bar voltmeter, which can be connected with each phase (by means of a three-way switch), and a synchronoscope for paralleling; also, a switch controlling the motor which actuates a main switch coupling the two sets of bus-bars together, and three electrostatic voltmeters showing the state of the insulation of the system with regard to earth. Each of the machine panels carries a field excitation ammeter, an ammeter showing the average current flowing to two phases, a power factor indicator, and a voltmeter; there are also provided a field regulating rheostat, a watt-hour meter of the induction type, throw-over switch for the main switch motor, and a switch for controlling the governor of the corresponding turbine (not used at present). All the panels carry red and green lamps, of which the former lights up when the main switch is closed, and the latter when it is open; this arrangement is necessary because there is no other indication on the front of the board to show whether the switch is open or closed. It is noteworthy that after careful consideration no mains-charging apparatus is provided.

The main switches are of very simple pattern, the standard of the British Thomson-Houston Co., who supplied all the switchgear. The main contacts are immersed in oil in gunmetal wells, each pole isolated from the rest in a brick compartment. The three switches connected with one generator or feeder are actuated together by means of a small motor, which acts against a powerful spring, extending the latter until a dead point is passed, when the switch goes in or comes out, as the case may be; a separate spring is provided for each motion. The motor is coupled to the switch mechanism through a worm and free-wheel, with a friction clutch, and the operation of opening or closing a switch consists simply in starting the motor in the appropriate direction by means of the throw-over switch on the operating panel. The motor then runs until the switch is actuated, and is automatically cut out after running a little longer—a certain amount of free running being allowed in either direction, to ensure the motor attaining full speed before it engages and begins to operate the mechanism. These switches can be operated by a lever on the switch itself if the motor fails. The generators are coupled direct to the bus-bars through these switches, without any automatic cut-outs; only the feeders are provided with the latter, which are of the overload type, and act as relays, closing the motor circuits so as to open the switches. Two of the brick compartments are occupied by transformers for reducing the pressure on the voltmeters. Five of the main switches—those controlling the feeders and the bus-bar dividing switch—are on the same level as the A.C. switchboard, the three generator switches being on the ground level, behind the D.C. switchboard.

From the foregoing description and our illustrations, it will be seen that the plant is of the most modern type, and is laid out with due regard to reliability, safety and economy in working. It is difficult to realise, on first entering the station, that the generating sets are 1,000 KW. units, owing to the small floor space and vertical height occupied by them. No difficulty seems to have been experienced in arranging the boilers near the turbines supplied from them, though, doubtless, this question will assume greater prominence when larger units are installed, for which reason the double row of boilers is required for future extensions.

The Great Eastern Railway runs near the works, and it is contemplated to construct a siding from it to the site, so as to provide an alternative means for the supply of coal and other materials. The light railways to Cheshunt will also pass near the station at a future date.

Special attention has been given to fireproof construction throughout the whole of the switchboard, and easy access provided to the underground H.T. cable trench.

The resident engineer in charge of the generating station is Mr. H. H. Perry, to whose kind assistance we were greatly indebted on the occasion of our recent visits to the works.

(To be continued.)

TRAMWAY AND RAILWAY NOTES.

(Continued from page 418.)

Liverpool.—The old subject of a universal 1d. fare on the electric tramways has been raised again, Councillor J. Wilson Walker having given notice of the following resolution:—

That, in the opinion of this Council, the time has now arrived for the introduction of a universal 1d. fare to and from all parts of the city of Liverpool, and that it be an instruction to the Tramways Committee to introduce such universal 1d. fare forthwith.

An inquest was held here last week regarding the death of a boy aged 8½ years, who fell in front of a car which was travelling at the rate of six or seven miles an hour. The driver was unable to bring the car to a standstill until the child had been pushed along about three yards, and its leg had become jammed beneath the plough-guard. In order to release the boy, the car had to be raised by means of planks and wooden blocks. One of the witnesses complained that there were no appliances on the car for the raising of the vehicle in order to liberate the boy. Mr. C. R. Bellamy, the tramways manager, said that the plough-guard which was fixed to all the Liverpool cars had a better record than any guard in the country. It was necessary to allow a 3-in. clearance from the ground, and therefore it was not to be expected that the limb of a child would not at some time pass beneath the guard. This was the first accident of the kind that had occurred since the adoption of this type of guard in 1901. He did not think that the provision of a screwjack on every one of the cars would be of much service, as it required mechanical ability to raise a heavy weight by this means. As a matter of fact, there was provided on this particular car a crowbar with which the guard-boards, only 1 in. in thickness, might have been split; but, unfortunately, that mode of liberating the boy was overlooked in the excitement of the occasion. A juryman suggested that the guard should be constructed in removable sections. Mr. Bellamy replied that the suggestion was worthy of consideration, and undertook that in future the guards would be secured with light bolts so that they could easily be detached. A verdict of "Accidental death" was returned.

Manchester.—A meeting of the Manchester City Council has been arranged for [illegible] week of October to deal with the provision of electric t[illegible] in the Bucklow Rural and Cheadle Urban Districts. [illegible]al notice will be given to the Manchester Southern Tramways Co., that the Corporation intends to exercise the powers, and assume the obligations, conferred or imposed on the company by the Manchester Southern Tramways Act, 1903, in relation to the construction, maintenance, and user of so much of the tramways authorised by that Act as are situate in the districts above mentioned. The intended new line will connect with the Manchester Corporation system at Palatine Road, and with the Stockport Corporation system at Gatley, with extensions to Altrincham, by way of Northenden and Sale. The route is an extremely popular one with holiday makers.

Sunderland.—At the meeting of the Tramways Committee on the 1st inst. the question of the covering of the cars was considered. As a sort of experiment, one double-deck car has been altered by the tramways staff and an upper covering added. This was inspected by the members of the Committee and met with general approval. It was decided to have six more so covered, and quotations for the work were put before the Committee from two car-building firms. The prices in both cases were higher than was the cost of the work done by the Committee's own staff. As a consequence it was resolved that the alterations should be done by the permanent staff, and the Committee decided to order some woodworking machinery to facilitate the execution of the work.

West Bromwich.—Our Wolverhampton correspondent writes:—"Many complaints are heard about the continued delay in running the tramcars from the New Inns at Handsworth, so as to connect with the Corporation trams at the boundary near the Albion Football Ground. The work of conversion to the overhead electric system has now been completed over three weeks, and the delay is therefore inexplicable The Handsworth District

Councillors assert that it is no fault of theirs, and members of the West Bromwich Council disclaim any responsibility. One explanation is that the Tramway Co. have to hand over a considerable sum of money to the West Bromwich Town Council in connection with the settlement recently arrived at respecting the dispute between them over the permanent way through the borough, and until this is paid West Bromwich will not, it is stated, supply the current for driving the trams beyond the boundary. It is recognised that the Tramway Co. are expending large sums of money for reconstruction in various parts of the district, but it is thought they must be losers in not connecting the line in question between the two districts, as the traffic since the stoppage of the steam trams has fallen off enormously. Whatever the cause of the hitch, it is hoped that the difficulty will soon be overcome, so that the tramway service from the Black Country to Birmingham may be completed."

TELEGRAPH AND TELEPHONE NOTES.

Liverpool Telephones. — "Penny-in-the-slot" telephones do not pay in Liverpool, and according to the *Manchester Guardian*, the system is to be abolished. No more instruments of this type will be issued. The system involves separate switchboards, additional staff, and a differential administration for which in the Liverpool head office there is not space at command. Penny-in-the-slot subscribers have been charged a subscription of £3 10s. per annum, and there has been a condition that if the pennies placed in the instrument in the course of a year do not amount to 30s. the subscriber is to make up the difference. This has involved a considerable amount of clerical work on the part of the Telephone Co.'s staff, and has caused some irritation on the part of subscribers. The National Telephone Co. offer in place of the penny-in-the-slot a system known as the X. and Y. Two separate subscribers may use the line in common at a charge of £6 per annum each. The disadvantage is that when one of them is using the wire it is blocked to the other; but each, if curiously disposed, can hear the conversation carried on by the other.

New Cable Opened.—The opening of a cable between Seattle Washington and Sitka Alask is announced.

State-owned Cables. — The *Daily News* quotes the terms of a resolution on this subject from the Association of Chambers of Commerce of South Africa, which is to be considered by the Capetown and other affiliated Chambers in South Africa. The resolution is as follows:—

"That in the opinion of this Association of Chambers of Commerce of South Africa, all the self-governing British communities around the globe should be united by a continuous chain of State-owned telegraphs;

"That such an inter-Imperial line of communication would, under Government control, put an end to the difficulty which has been caused in Australia by the allied cable companies, and remove all friction which has arisen between the partners in the Pacific cable;

"That it would lower charges to a minimum on oversea messages passing between New Zealand, Australia, India, South Africa, the West Indies, Newfoundland, Canada, and the Mother Country.

"That it would provide a double means of communication at low, uniform rates between the Mother Country or any one British State, and all self-governing British States; that it would constitute the most effective means by which the several Governmental units of the Empire may hold communion with each other whenever they desire;

"And that while it would be of the highest importance to the commercial and social interests of the British people around the world, it would, by the subtle force of electricity, at once promote the consolidation of the Empire and prove an indispensable factor in Imperial unity."

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1304	
Paramaribo-Cayenne	July 13, 1904	
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904	
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto Bairros	July 28, 1902	
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Caimanera-Santiago	June 15, 1904	
Rome-Constantinople	Sept. 2, 1904	Sept. 2

Wireless Telegraphy.—It is reported that a French company has submitted a scheme to the Roumanian Government for an installation of wireless telegraphy between Constanza and Constantinople.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen. — September 27th. Twenty top-deck car covers, for the Tramways Committee. See "Official Notices" September 2nd.

Barking Town.—September 20th. Rails, permanent way, overhead equipment, and feeder cables, for light railways extensions. See "Official Notices" August 26th.

Brazil.—The municipal authorities of Nova Friburgo, near Rio de Janeiro, are about to invite tenders for the establishment of a central station for the electric lighting of the town.

Burton-upon-Trent.—September 22nd. Steam piping for the electricity works. See "Official Notices" to-day.

Edmonton.—September 27th. The U.D.C. invites offers from companies willing to carry out its electric lighting provisional order. See "Official Notices" August 26th.

France.—September 29th. The municipal authorities of Paris are inviting tenders, until September 29th, for the supply and erection of a gas engine and dynamo of a capacity of 7 KW. at the municipal electric lighting station at the Square Saint Pierre. Particulars may be obtained from, and tenders are to be sent to, l'Hotel de Ville, Paris.

Holland.—September 22nd. The municipal authorities of the Hague, Holland, are inviting tenders, until September 22nd, for the supply of 8,000 to 9,000 tons of steel rails for electric tramways.

India.—September 13th. The Secretary of State for India is prepared to receive tenders from such persons as may be willing to supply (1) compressed paper blocks; (2) carriage and wagon wheels and axles; (3) electrical plant. Conditions on application to the Director-General of Stores, India Office, Whitehall, S.W.

Isle of Thanet.—Stores for the Isle of Thanet Electric Tramways and Lighting Co. See "Official Notices" to-day.

Johannesburg. — September 12th. 300 Alternate current and 300 direct current meters, also 600 fuse boxes for the T.C. See "Official Notices" September 2nd.

Leeds.—September 12th. Wiring installation, also subway and underground concentric mains for lighting new hospital blocks and workhouse. See "Official Notices" September 2nd.

Leyton.—September 23rd. Electric wiring and fittings for Newport Road School. See "Official Notices" September 2nd.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Philippopoli.—October 2nd—15th. The Municipality is inviting proposals for the installation of electric lighting and tramways in the town. A copy of the official announcement in French will be found in the *Times* for September 5th. M. Penkoff is the chief of the technical section.

Servia. — October 2nd. Tenders are invited until October 2nd, by La Société Oratschar et Kablar, at Tchatschak, Servia, for the supply of two sets of turbines and dynamos for their central electric lighting and power station.

Tynemouth.—September 30th. One 600-KW. steam dynamo for the Corporation. See "Official Notices" to-day.

Wallasey.—September 14th. High tension switchgear for the U.D.C. See "Official Notices" September 2nd.

West Ham. — September 13th. Tramway poles, wires and fittings for the Council. See "Official Notices" August 26th.

CLOSED.

Batley.—The tender of the British Westinghouse Co. has been accepted by the Corporation for the supply of a steam dynamo and accessories at the electricity works.

Brighton.—The T.C. has placed an order with the Torbay Paint Co. for 400 gallons of paint for the Aldrington Electric Light Station at 4s. per gallon.

Colwyn Bay.—A correspondent says that the whole of the contract (about £80,000) for the construction of the permanent way, cables, and electrical fittings in connection with the tramway and light railway between Colwyn Bay and Llandudno has been secured by Messrs. F. W. Smith & Co., Ltd., electrical contractors, Southport.

Dartford.—The U.D.C. has accepted the tender of the Western Electric Co. for the supply of cable, at £850, and that of Messrs. Nalder Bros. for alterations to the switchboard.

France.—The French Post and Telegraph Authorities in Paris have just given out contracts as follows:—

M. de la Mathe, of St. Maurice (Seine), 60 kilometres of telephone cable with seven pairs of conductors, at 1,585 fr. per kilometre.

Messrs. Geoffroy & Delore, of Clichy, 60 kilometres ditto, at 1,690 fr. per kilometre.

M. Grammont, of Pont de Cheruy, 12 kilometres ditto, with 56 pairs of conductors, at 6,180 fr. per kilometre; 12 kilometres ditto, with 112 pairs of conductors, at 8,960 fr. per kilometre.

Messrs. Aboilard & Co., Paris, 32 kilometres ditto, with 7 pairs of conductors, at 6,200 fr. per kilometre.

Glasgow.—The Sub-committee on the Fire Brigade has recommended the Corporation to accept the National Telephone Co.'s offer to fit up additional fire-alarms at various points in the city for £26. The Corporation Telephone Department also tendered, but the N.T. Co.'s offer is the lowest.

In connection with the district libraries now being erected by the Town Council, throughout the city, the following offers for electric fittings have been accepted:—

Anderston—Wm. McGeoch & Co., Ltd.	£130
Govanhill—J. D. Mackenzie & Co.	289
Maryhill—Malcolm J. Allen	322

Leeds.—The Lighting Committee of the T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of 130 continuous current lamps at £3 11s. 6d. each, and 300 alternating current lamps at £4 12s 6d. each.

London.—The Metropolitan Asylums Board accepted, on Saturday, the tender of Messrs. Baxter & Impey, of Birmingham, at £137, for installing internal telephones at the Eastern and Western Hospitals.

The Board has also accepted the tender of Messrs Vickers, Sons and Maxim (at £2,279) for the engines, dynamos, extra boilers, and electrical power equipment for the new training ship.

London.—The contract for the hydraulic lift installation for the Finsbury Park Station, Great Northern Railway, and Underground Railway of London, has been placed in the hands of Messrs. C. & A. Musker, Ltd., of Liverpool. This is a similar installation to that which this firm are just completing for the Great Northern and City Railway Co.'s Highbury Station, but of a larger size.

Philadelphia, Pa.—The J. G. Brill Co. will supply 150 trolley cars for the Metropolitan Street Railway Co., of New York City. These cars are to be 28 ft. long, and will seat 40 persons. The same company will also construct 150 cars for the United Railways and Electric Co., of Baltimore, Md. These will be smaller cars, 16 ft. long, seating 28 persons and costing $2,400 each.

Poplar.—The B.C. has received the following tenders for a condensing plant motor:—

R. Woods & Co.	(recommended)	£240 10
Bruce Peebles & Co.		260 0
Do. do. (alternative)		275 0
Electromotors, Ltd.		267 17
Cutting Bros.		290 0

For the supply of coal to the generating station to the end of March, 1905, nine tenders were received, and that of Messrs. Facer and Co. offering Hardwich, Pilsley and Staveley at 11s. 2d. per ton, delivered by rail, is recommended. This price works out at ·366d. per B.T.U., as against ·418d. per B.T.U. under the last contract.

Redditch.—The U.D.C. has placed an order with Mr. William Boby, for two of his No. 10 Heater-Detartarisers for its electricity station; each is to be capable of treating 1,000 gallons per hour.

Sunderland.—At the meeting of the River Wear Commissioners held on the 31st ult., the tenders of Messrs. Stothert and Pitt, Ltd., for the supply of electric cranes, capstans, and motors for the new traffic quays at the Hudson Dock North was accepted.

Tyldesley.—The South Lancashire Tramway Co. has accepted the tender of Messrs. Krauss & Son, of Bristol, for the construction of the tramway from Tyldesley to Boothstown.

War Office.—The Army Council of the War Office has placed a contract with Messrs. Geipel & Lange, for 38 Geipel's patent steam traps, to be fitted at the Royal Gunpowder Factory, Quinton Hill, Waltham Abbey. This is the seventh repeat order which they have received for this factory, and will make a total of 210 Geipel traps fitted there.

Warrington.—The Electricity and Tramways Committee of the T.C. has accepted the tender of the St. Helens Cable Co., Ltd., for the supply of cables for the Light Railway No. 1, at £376 13s.

FORTHCOMING EVENTS.

September 14th, 15th and 16th.—Institution of Mining Engineers. Annual general meeting to be held in Birmingham. Dinner on 14th. Excursions and visits to various collieries and works have been arranged.

September 27th, 28th and 29th.—Municipal Tramways Association of Great Britain. Annual Conference to be held in Liverpool. Full particulars are given in our "Notes" columns to-day.

NOTES.

Behaviour of Dielectrics to Direct and Alternating Current.—Some experiments have been carried out recently by the Campagnie de l'Industrie Electrique, of Geneva, on the relative behaviour of dielectric materials towards direct and alternating currents. It has been found that all dielectric substances, and all insulating materials, exhibit a higher degree of insulating power against a direct current than against an alternating one; and that the insulating materials are not at all heated by the direct current. The latter, however, has the disadvantage that it electrolyses certain insulating materials; but inasmuch as this action only occurs in presence of water, substances such as glass, porcelain, and mica are free from it.

Electrolytic Preparation of Vanadium and its Alloys.—Mons. G. Gin, of Paris, has taken out a German patent for a process of obtaining vanadium and its alloys, which depends on the high electrical conductivity of vanadium trioxide, and on the ease with which that body is converted into the corresponding fluoride when acted upon by fluorine in presence of carbon. Ferric fluoride is dissolved in molten calcium fluoride, and the bath is electrolysed with the aid of an iron cathode and an anode composed of an intimate mixture of vanadium trioxide and carbon. The ferric fluoride is dissociated, and the nascent fluorine attacks the vanadium trioxide to form vanadium fluoride (VF_3), while the oxygen which is set free combines with the carbon to yield carbon monoxide. The vanadium fluoride then dissolves in the fused calcium fluoride, and is decomposed by the current. The vanadium combines with the iron liberated at the cathode from the dissociation of the ferric fluoride, and the fluorine produces a fresh quantity of vanadium fluoride at the anode. The anode is prepared by igniting a mixture of vanadic acid and retort carbon so as to form an intimate mixture of vanadium trioxide and carbon. This is treated with a suitable proportion of hot tar, and the whole is ground into a homogeneous mass. It is then compressed into hollow or solid rods, which are strongly heated in the absence of air. The anode in the electrolytic process consists of a bundle of these rods of such a size that the anodic current density is 2 amperes per square centimetre; while the cathode is a block of steel of such dimensions that the cathode density is 6 amperes per square centimetre. The tension of the current ranges from 10 to 15 volts. The ferric fluoride is only required to start the process; but in order to make good a small loss of fluorine caused by the production of carbon fluoride, a little more ferric fluoride is added to the bath at intervals. The iron needed to combine with the vanadium liberated is introduced in the metallic state at the start, more being added each time some of the alloy is withdrawn from the bath. Alloys of vanadium with copper, aluminium, manganese, &c., may be obtained in a similar fashion.

Municipal Tramways Association of Great Britain.—The annual Conference of this Association is to be held in Liverpool from 27th to 29th inst. Mr. C. R. Bellamy, the city tramways manager, is president for the year, and the arrangements so far made for the meeting are as follows:—

Tuesday, September 27th.

Meeting of Executive Committee at 9.45 a.m.
Meeting of Manager Section at 10 a.m.
Reception by the Corporation of Liverpool at 10.30 a.m.
Conference at 11 a.m.
Dinner to be given by the Liverpool Corporation at 7 p.m.

Wednesday, September 28th.

Meeting of Executive Committee at 9.45 a.m.
Business Meeting of Association at 10 a.m.
Conference at 11 a.m.
Visit Lambeth Road Works and Pumpfields Power Station during the afternoon.
Association Dinner at 7 p.m.

Thursday, September 29th.

Excursion.

Papers:—Papers on the following subjects will be submitted for discussion, viz.:—

"How to Effect Economy in Current Consumption," by Mr. P. Fisher.
"Arrangement of Men's Duties," by Mr. J. B. Hamilton.
"Methods of Dealing with Mixed Systems of Traction," by Mr. A. L. C. Fell.
"Cars, their Equipment and Maintenance," by Mr. J. Aldworth.
"Overhead Equipment; Construction and Maintenance," by Mr. J. M. McElroy.

The following reports will also be submitted:—
Report on the Standardisation of Tramway Accounts.
Revised Report on the Hours of Labour, &c., of Tramway Employés.

Mr. J. M. McElroy, the general manager of the Manchester Corporation Tramways, is secretary of the Association.

Electric Traction on the Trans-Siberian Railroad.—A paper has been read before the third Russian Electrotechnical Convention at St. Petersburg by Count A. F. Lubienski, concerning the desirability of adopting electric traction on the Trans-Siberian Railroad. The author assumes that it will be necessary to operate 40 to 50 trains per day. The speed of the trains under present conditions is limited by light rails, by the bad profile of the road and by lack of water. To eliminate the effect of the light rails and bad profile would entail a great expenditure of money and time, so that it would prove more economical to establish electric traction on some sections of the railroad. The construction of the line could

then remain unchanged and high speeds could be attained even on sharp curves. In the case of electric traction the question of water supply is not of great concern, for the central stations could be established in the neighbourhood of large lakes or rivers, at a distance of 75 to 150 miles from each other, and current could be sent at 75 to 100 kilovolts in both directions. In spite of the difficulties in obtaining electric materials and a technical staff, it would be easier to adopt electric traction than to undertake the rebuilding of the whole line. In concluding, the author asks the opinion of engineers on the question generally. Another paper, by G. O. Graftio, gives some data respecting electric traction on the railway lines of the Caucasus in Russia. Owing to the fact that steeper grades can be allowed without diminishing the capacity of the railway, and that water power abounds, the Caucasus is particularly well adapted for carrying out such work. The Toapse, Chakhe, Mzimiou, Psoou, Bzib, and Kodor Rivers, which drain an area of 300 to 2,000 sq. km., and whose output is 80 cu. metres per second, illustrate these conditions. In comparing the cost of electric with steam traction for a 220-km. line on the shores of the Black Sea, the author bases his calculations upon data taken from the Lekko-Kiavenna electric railway and the Uladicaukasus steam road. The approximate cost of a generating and transmission equipment would exceed the cost of the steam road by a sum of $5,000,000; the annual expense would, however, be less in the case of electric traction, independent of any consideration of expenditure on water ducts, &c., and a profit of $4,000 per km. would result in the case of electric traction. These considerations are stated to point to the economical success of electric traction, and the author proposes that efforts be made to carry out such a scheme.—*Electrical World and Engineer.*

McMillan Memorial Fund. — It will interest our readers to learn that the contributions received toward this fund up to September 5th, 1904, inclusive, amounted to £1,709 16s. 10d., viz.:—

Members	£923	1	4
Associate members...	265	3	0
Associates	262	16	4
Students	52	1	3
Foreign members	24	18	0
Subscriptions from non-members ...	181	16	11
	£1,709	16	10

There is still time for those who wish to help to bring up the total to the proposed £2,000, to send in their subscriptions.

New Planing Machine Drive. — The *American Machinist* of June 18th last, contains a description of an ingenious belt drive for planing machines, which has been adopted on several 7 ft. to 14 ft. machines of this type at the British Westinghouse Works, Trafford Park. The apparatus was introduced by a Mr. W. C. Mitchell, and has supplanted both shifting belts and magnetic clutches, the machines being speeded up to take advantage of high-speed cutting steel tools. The feature of the drive is the substitution of two vertical belts (forward and reverse) having a surplus of length and provided with tightening pulleys on their slack sides, in place of the usual shifting belts. The tightening pulleys are operated either directly from the table dogs or by means of compressed air. The arrangement consists of a first countershaft driven from a motor and driving through open and closed belts on to two secondary countershafts; from these the two vertical drives fitted with tightening devices previously mentioned, are taken. As the factor which limits the amount of the power which can be put into a planer with the ordinary drive, is the difficulty of shifting large belts, it is evident that the above arrangement gets over a difficulty in the case of large machines.

Australasian Electrical News.—We are indebted to the *Australasian Hardware and Machinery* for the following particulars:—

All the generating machinery at present working in the Ultimo (Sydney) tramway power-house is of American make. The new plant now being installed is of British manufacture, and is expected to be ready for operation by the end of the year, when the Botany tram line will be converted from steam to electric power. Last year the Railway Commissioners let contracts for the supply of additional electrical plant, involving an outlay of something like £50,000, comprising a Parsons turbo-alternator of 1,875 KW., and 16 Babcock & Wilcox water-tube boilers, each 250 nominal H.P.

The electric trams at Wellington were made available to the public on the last day of June, one of the main sections having been completed. Four cars, an ordinary and three "double-deckers," maintained a seven-minute service throughout the day.

The first year's running of the Auckland electric tramways proved very successful. Under its agreement with the London company who own the property, the City Council is entitled to 5 per cent. on the net annual profits, up to £5,000, with 10 per cent. of all profits in excess of that sum. As a result of the first year's work the Council has received a cheque for £2,013, which, on the suggestion of the mayor, is not being paid into the general revenue, the idea being to establish a fund with which to purchase the trams at the end of the term. Such a course will require the sanction of Parliament.

The Hobart Tram Co. recently imported a new type of car to serve as a model for others which it is their intention to construct. Its length is 30 ft. 3 in.; height, 16 ft. 8 in. outside, and 6 ft. 9 in. inside. To prevent any objectionable rocking, it has been mounted on Brill bogies, with four wheels each. Two 25-H.P. motors are installed, and the controlling apparatus is of the Siemens-Schuckert type. The speed developed is 16 miles per hour on a level way, and 8 miles per hour on a gradient of 1 in 4. The car was manufactured by Hurst, Nelson & Co., of Motherwell, and cost £1,100.

Electric v. Hydraulic Cranes for Riveter Towers. —Writing in the *Electrical World and Engineer*, Mr. Frank B. Kleinhans points out that there are a number of hydraulic cranes in operation which have a capacity of 25 tons, and yet the average weight on these cranes is less than eight tons. The crane is thus operating with three times as much power as will actually be required to do the work. In addition to this, the total pressure on the frame of the hydraulic hoist is made 25 per cent. greater than is theoretically required to lift the load, this being allowed to overcome the friction of the chain, shives, idlers, &c. It can readily be seen that, under these circumstances, the cost of operating the hydraulic crane is several times greater than that of an electric crane. We can take an electric crane, for instance, and raise the hook from the ground to its highest position in the riveting tower with the expenditure of little energy. With the hydraulic crane, however, just as much power is required to raise the empty hook as would be required to lift so heavy a load that the crane would barely be able to move it. To move the trolley of a hydraulic crane under a heavy load is no easy work, the reason being that the chain which carries the load must be "overhauled," and as the shives are comparatively small, a great deal of energy is necessary to pull the trolley along to do the "overhauling."

In an electric crane a power traverse can be employed anywhere. The moment the hydraulic crane valve is open, the water rushes into the cylinder at such a high velocity that it is impossible to get a fine adjustment of the hook. This, of course, is an important thing, as the centre line of a rivet should always be central with the dies. There is another class of work which must be done on the riveting machine, namely, that of driving the rivet in diametrical seams. For this work the boiler should be supported at a constant height. As there is always more or less leakage about the gland, connections, &c., of an hydraulic crane, the hook will gradually settle, and thus every now and then it is necessary to raise the boiler a little before being able to go on with the work.

With the electric crane most of these objectionable features disappear. The vertical adjustment of the hook can be made as fine and delicate as desired. As an automatic brake is provided on all electric cranes, it is impossible for the load to drop, even when the source of supply is cut off.

The cost of an electric crane, equipped with power traverse for the trolley and the bridge, will just about equal that of the trolley chain and hoist, while the cost of an electric crane with hand traverse will be somewhat less than the hydraulic equipment. The cost of operating the electric crane is so much lower than that of the hydraulic, that it is almost unnecessary to make any comparison. The power consumed by any electric motor is very closely proportional to the amount of work performed. In the general run of work on riveting machines there is a great deal of light work handled, and, of course, economy on the part of the crane for handling this work would be an item of considerable importance.

In conclusion, it is mentioned that electric cranes are being used in several boiler shops to advantage.

Third Rail Protection.—"M.Inst.C.E." writes to the *Engineer* as a railway man, in regard to a statement made by our contemporary that "As the upper surface of the (live) rail must be left clear for the slippers, the only possible protection consists of boards on one or both sides of the rail," &c. This, he says, is not so, and adds: "Allow me to refer you to the Wilkesbarre and Hazleton Railway, in America, where the live rail is protected from above, and very nearly fool-proof. This is described very fully in a work published by the McGraw Publishing Co., of New York, viz., 'Notes on Electric Railway Economics,' by W. C. Gotshall, of the New York and Port Chester Railroad Co. The type of slipper is, of course, different from the one in use on the North-Eastern electrified lines, but there is nothing to prevent its adoption by that company at very little expense, after which the timber protection from above could be proceeded with. It is questionable to my mind whether the present system of protection by means of boards on each side is a suitable one. The trough so formed will fill with snow and sleet, and, with a convenient frost afterwards, freeze up and render the service *hors de combat*. As many of the North-Eastern officials are again going to the States to gather information, no doubt they will take the opportunity of investigating this important subject."

River Plate Notes.—The *Review of the River Plate* says that the Government has resolved to install a wireless telegraphy plant in the lightship that is to be placed at the entrance to the River Plate. This will enable vessels coming to Buenos Ayres to communicate with the port at a distance of 180 kilometres.

The recent heavy storm occasioned the fall of many of the rotten telegraph poles that exist throughout the city. The electric tramways were the sufferers, as traffic had to be suspended in many streets.

Mr. M. Henlistka, the representative of the Cia. Alemana Transatlantica de Electricidad, has approached the Rosario Municipality in connection with the construction of electric tramways in that city. Everything now points to Rosario having electric traction before many months.

Fatality.—On the 2nd inst., at Bury, an inquiry was held touching the death of Joseph Fisher Dands, 31, a journeyman electrician, in the employ of the Salford Tramway Committee. On Tuesday last week deceased, along with a man named Joseph Martin, was working on the overhead wires at Whitefield, where the Salford lines are joined to Bury. They had taken the slack out of the trolley wire, and Dands was standing on the platform near the two insulators which had been used to cut off the current. Martin was gathering up the tools, when he heard deceased cry

"Oh," and turning round saw him hanging over with his hands on the wire. Martin rushed for a hammer with which to tap deceased's hand and draw the current, but before he could do so deceased had fallen over the side of the stage to the ground, a distance of about 20 ft. In answer to Mr. Jackson, who represented the Salford Corporation, Martin said deceased was not wearing gloves. The men were instructed to carry gloves, and notices were put up to that effect, and in addition there was a spare pair in the trolley. Deceased was a foreman, and knew the danger of touching a live wire. Dr. Alsop, junior resident medical officer at the Bury Infirmary, said deceased was suffering from fracture of the skull, with laceration of the brain, and died from those injuries, and not from the electric shock. There was a slight burn on the left forefinger, and one on the calf of the left leg. A juryman suggested that if the sides of the cage had been higher deceased would not have fallen over. Mr. Jackson pointed out that the cage was specially constructed for the purpose. The rails were insulated, and if deceased had taken the precaution he was instructed to do, he would not have met with the shock. A verdict was given in accordance with the medical evidence, and several jurymen expressed satisfaction that the Salford Tramway Committee had brought the trolley for the inspection of the jury.

Telephone Lead-Covered Cables Attacked by an Insect.—From an article appearing in a recent issue of the *Electrical World and Engineer*, we learn that the China and Japan Telephone Co., of Shanghai, China, has had an extraordinary experience in cable trouble, caused by the attack of an insect which pierced the lead covering of its telephone cables. It was noticed several years ago that the lead sheathing of the aerial cables was perforated by holes, which admitted water and gave rise to much trouble. It was assumed that the injury was caused by small rifle bullets, and a reward of 50 taels was offered for information that would lead to the punishment of the wrongdoers. Later it was established that the holes were the work of wasps of a species that lays its eggs in the living bamboo. These wasps gather around bamboo groves in July and August to lay their eggs inside of the cane, where they will be well protected from attacks of hungry enemies. The cables were never attacked any distance away from bamboos. As immediate protection linseed oil boiled to the consistency of birdlime was used, and later all cables in the localities where damage had been done were covered with hemp cloth so as to present a soft surface which the insects do not attack. Our contemporary gives illustrations from photographs of injured cables, showing that the insects made several attempts before they succeeded in perforating the sheathing.

Workmen's Compensation Act.—A return has been issued by the Home Office giving statistics of the proceedings under the Workmen's Compensation Acts, 1897 and 1900, and the Employers' Liability Act, 1880, during 1903. The *Times* makes the following extracts from the "General Remarks" in which the report sums up the results shown:—

"Speaking generally, a comparison of the returns for 1903 with those for the years 1899 to 1902, the first four complete years when the Workmen's Compensation Act was in force, does not show any great change in its operation.

"Compared with 1902, the year shows an increase in the number of cases taken into the Courts, but a decrease in the number of appeals to the Court of Appeal. As in previous years, the great majority of claims were settled by agreement, and only a small percentage were made the subject of formal arbitration.

"In cases of death, where the claims are for comparatively large sums, we should expect to find that a good many are disputed. We have accurate statistics of the number of deaths by accident in railways, factories, mines, and quarries."

After giving these figures in the form of a table, the report proceeds:—

"Even in case of death, therefore, where large sums would generally be payable, not more than 22 per cent. of the cases came in any way before the Court, and this figure includes a good many cases finally settled out of Court, and others in which the only question was the apportionment of the compensation among the dependants. In 1899 the proportion was 15 per cent., in 1900 14 per cent., in 1901 18 per cent., in 1902 18 per cent.

"As regards claims for injury, though there are no official figures of the number of persons injured, which are of any value in this connection, the statement may be repeated that the unofficial figures available in certain industries indicate that the number of litigated cases is probably not more than 1 per cent. of the total number of cases in which compensation is payable."

With regard to the charge placed upon the railway companies by the Act, it appears from figures furnished by the companies to the Board of Trade that the amount paid by the railways of the United Kingdom as compensation under the Act, including payments to insurance companies and to funds under schemes certified to cover liabilities under the Act, rose from £118,849 in 1899 to £153,928 in 1991, declined to £144,155 in 1902 and rose again to £155,495 in 1903.

Third-Rail Location in the U.S.—According to the *Street Railway Review*, there are now some 30 or more companies operating electrical systems in which current is transmitted to the car through a third-rail, but there is no uniformity in the practice as regard the location of the conductor rail with reference to the track rail. The elevated railroads place the centre of the conductor rail about 20 in. (from 19½ to 22¼ in.) from the gauge line of the nearer track rail, and the surface of the conductor rail from 5¼ to 7½ in. above the surface of the contact rail. On interurban roads these dimensions are about 20 in. from the gauge line to the centre of the conductor rail, and from 5¾ to 7½ in. for the vertical distance between the tops of the two rails. The Albany and Hudson Railroad is an exception, as it places the conductor rail 27 in. away instead of 20 in, and makes the height 6 in. above the track rail. The dimensions adopted for the new work of the Baltimore and Ohio electric track are 30 in. and 3½ in. respectively. The New York Central, for the electric tracks for its New York terminus, has the dimensions 27 in. and 3½ in. respectively. In the New York Rapid Transit subway they are 26 in. and 4 in. The New York, New Haven and Hartford, the Central London Railway and the Liverpool Overhead Railway place the conductor rail in the centre with the surface 1½ in. above the top of the track rail.

The requirements in locating the conductor rail at a higher elevation than the track rail are principally two; a rail should be high enough so that at crossovers and turnouts the shoe which takes the current will not strike the track rails, and, second, the conductor rail should be sufficiently high above the ties to permit of satisfactory insulation. Opinion varies as to the type of insulator that can be used to advantage. With the adoption of electricity for motive power on steam railroads, and the further extension of existing electric interurban lines, the time will eventually come when it will be desirable to interchange electric cars to a considerable extent, and the position of the third-rail should be standardised. The present is the proper time to bridge the difference between 20 in. and 27 in. and between 6½ in. and 3½ in., which dimensions now characterise interurban and main line electric third-rail practice.

Electricity in Mines: The New Rules.—At the annual meeting of the Midland Counties Institution of Engineers, held at Nottingham on Saturday, there was some discussion on the proposed rules respecting electricity in mines. According to an account of the discussion given in the *Times*, Mr. Maurice (Hucknall) submitted that they were not sufficiently workable to be accepted as a section of the mining laws. The rules were excellent, and every colliery manager ought, on his own initiative, to carry them out. The difficulty was, however, that it was not practically possible to maintain the electrical plant in the way specified, and therefore the rules ought to be voluntary, and not compulsory. Mr. A. B. Markham, M.P., criticising several of the rules, remarked that, although it was considered safe to carry bare wires in large towns where thousands of people were constantly passing, yet in the opinion of the gentlemen who framed those rules it was not safe to have traffic under wires in mines. The adoption of the rules as they now stood would throw a grave responsibility on the colliery managers. He thought that was unfair, when the responsibility rested much more with the owners themselves, who decided whether work should be done cheaply, or with the very best materials that could be obtained. There ought to be a clause providing that where a manager had recommended certain expenditure to the directors as necessary, and loss of life resulted from their refusal or neglect to allow that expenditure, all responsibility should devolve upon the owners.

The Distillation of Metals.—MM. Moissan and O'Farrelley have recently described before the Académie des Sciences some experiments upon the distillation of metallic mixtures in the electric furnace by the aid of a current of 450 to 500 amperes at a tension of 110 volts. The mixtures tested were copper-zinc, copper-cadmium, copper-lead, copper-tin, and tin-lead. They find that these mixtures may be divided into three classes, which behave on distillation like the corresponding three classes of liquid mixtures. For instance, a mixture of copper and lead behaves on distillation like a mixture of partially miscible liquids, such as water and ether. A mixture of tin and lead resembles a mixture of water and alcohol. A mixture of copper and tin behaves like a mixture or water and formic acid, *i.e.*, at a certain temperature, which, however, is very high, both substances have the same vapour tension. Hence the laws governing the fractional separation of two liquids by distillation apply also to the distillation of metals at elevated temperatures.

Formation of Hydrocyanic Acid in the Electric Arc.—A communication was made to the Academy of Science at Buda-Pesth recently on the above subject by H. Auer, who has studied the influence of the arc upon mixtures of oxygen and hydrogen, or acetylene, and upon ammonia alone or mixed with certain hydrocarbons or other gases. The author finds that with a current density of about 700 amperes per square decimetre of diameter, when dry ammonia is brought into contact with the arc, about 36 per cent. of the nitrogen it contains is converted into hydrocyanic acid, or into ammonium cyanide. If the ammonia is mixed with an equal volume of carbon monoxide or air, the proportion of nitrogen converted is only slightly increased. In presence of hydrogen, the extent of the conversion reaches 51 per cent., and in that of acetylene, about 65 per cent. The acetylene may be replaced by any other hydrocarbon, which, like methane, yields acetylene when exposed to the action of the arc. The amount of atmospheric nitrogen converted into hydrocyanic acid by the arc is also increased as the amount of hydrogen or of acetylene in the air treated is raised. The extent of the conversion is proportional to the current density.

Electrolytic "Galvanisation."—Gabran has recently described his process and apparatus for the electrolytic deposition of zinc on the large scale. He employs a bath containing 1,200 parts of zinc sulphate, 60 parts of sulphuric acid of 24° Bé. (specific gravity about 1·2), and 6,000 parts of water. The current density is 80 amperes per square decimetre, and the E.M.F. 50 volts. The operation only requires 7 seconds.

The Ekstromer Accumulator.—We understand that a new accumulator is shortly to be put on the market by a concern known as the Ekstromer Accumulator Co., Ltd., of 13, Walbrook, E.C, which is also contemplating the manufacture of electrical motor-cars. No particulars of the cell are as yet available; but it is stated to be especially adapted for automobile work. As proof of this it may be stated that an electrical Victoriette, fitted with a battery of 48 cells, has been twice driven from London to Reading and back, each time on one charge, the mileage covered being 84½ and 89 miles respectively. Recently a more ambitious test was essayed—that of driving to Bath on one charge. The run was successfully accomplished, the 108⅞ miles being covered at an average speed of 13½ miles per hour. At the start, the E.M.F. of the cells was 108 volts, and at the end 92 volts. As it is stated to be quite safe to run the Ekstromer battery down to 82 volts, the distance on one charge could easily have been exceeded. We may add that the weight of the battery, in running order, is 13 cwt. 3 qrs. 12 lbs.; the car complete, with accumulators, but without passengers, weighing 30 cwt. The claims made for the Ekstromer accumulator are its large output in proportion to weight, its capability of withstanding sudden rapid charges and discharges at very high rates, and low first cost.

Fire Alarms.—On Saturday the Metropolitan Asylums Board considered reports from the engineer-in-chief as to the condition of the fire alarm system at Gore Farm (Upper) Hospital. He was of opinion that the system was of a somewhat crude nature, and suggested that there should be a central indicator board, and that each block should have pushes connected therewith. Instructions were given for the Works Committee to carry out the work, the estimated cost of which is £350.

Finsbury Lectures.—We are informed that the Monday evening lectures, from October to Christmas, at the Technical College, Finsbury, will be given by Prof. Thompson, on the subject of "Single-phase Alternating Work," including single-phase motors, the design of single-phase transformers, and the analysis of harmonic curves. The Wednesday evening lectures will be given partly by Mr. P. M. Hampshire on "Electrical Measurement," and partly by Prof. Thompson, on "Magnetism."

Appointments Vacant.—The L.C.C. is wanting a demonstrator in engineering, with a knowledge of electrical engineering and practical mathematics, for the Paddington Technical Institute (£150); a demonstrator and assistant lecturer in electrical engineering is required for the Heriot Watt College, Edinburgh (£150). A chief assistant for Falkirk electricity works (£100); instructor in electric wiring for the Redhill Technical Institute; shift engineer for Burton-upon-Trent (£2); chief assistant for Kilmarnock (£130); also traffic superintendent (45s.); wiring inspector for Durban (£300). See our advertisement pages to-day.

Electrical Schemes at Rio de Janeiro.—The *St. James's Gazette* correspondent at Rio reports that the Rio Light and Power Co. has been started there, with a capital of £10,000,000. He says that the undertaking intends to acquire all the tramway lines in the capital and suburbs and reduce them to one type, and to furnish energy for numerous manufactories and electric lighting for the whole of the city.

International Association of Municipal Electricians.—The ninth annual convention of this Association will be held at St. Louis on September 13th and 14th. On Thursday, September 15th, a joint session of this Association and Section G of the International Congress will take place. This section is devoted to "Electrical Communication."

New York City Subway.—A New York correspondent writes:—"After interminable delays, due to labour troubles, the opening of the subway has been again postponed, and the best promise that can be made is that the Interborough Railway Co. will give the mayor at least six weeks' notice when the time comes to make a final declaration. On August 18th, Mr. August Belmont, president of the company, ran the first experimental train driven by electricity, previous experimental trains having been propelled by oil engines. The trip from City Hall to Harlem (a route almost entirely analogous to that from the Bank to Shepherd's Bush) occupied 15 minutes, the distance being about 8 miles. The wage for motormen is at the rate of $3 (12s.) a day, and, as a result of labour agitation, preference is to be given to men formerly employed on the electric cars on the elevated lines. Candidates must be between 21 and 40, and be at least 5 ft. 7 in. in height. The motormen and conductors are being trained in a special school, and in a number of school-cars, and no man will be put in charge of a train until he has had at least six weeks' probation. A number of steel cars have been received for running in the tunnel. These cars are entirely of metal, except as to the seats, the flooring and the window sashes; and while running, the corridors will be closed, so that in the event of fire the flames would not spread."

An American Single-Phase Railway.—In a week or so, says the *Western Electrician*, the Kewanee, Cambridge, and Geneseo Railway Co. expects to begin grading for an interesting 30-mile electric railway to be built between Kewanee and Geneseo, by way of Cambridge, in Henry County, Ill. The single-phase alternating current system will be used throughout. The power house will be located near Cambridge, and will be of 1,000 kw. capacity at the start. Current will be generated at 2,200 volts, and transmitted at 11,000 volts to the two end divisions of the road, where step-down transformers will be located to reduce the electromotive force to 2,200 volts, which will be the line voltage. The central division will be supplied at 2,200 volts directly from the power house. On the locomotives and motor-cars the voltage will be again reduced to 500, at which the single-phase motors will operate. The rolling stock will include two 40-ton electric locomotives, each equipped with four 250-volt motors (two in series) of an aggregate capacity of 600 H.P. There will also be 10 passenger cars, each fitted with four 75-H.P. motors and 20 coal and box cars. As will be surmised from this equipment, the company expects to haul coal and heavy freight under steam-railroad conditions. It is expected that 40 per cent. of the receipts will be from passengers, and 60 per cent. from freight. The road will be laid with 60-lb. rails, the maximum grade being one per cent. and the maximum curve five degrees. The passenger traffic will be carefully looked after, as is shown by the fact that the company has purchased 72 acres of land between Cambridge and Geneseo for a pleasure park. The road will be built across country on the company's own private right-of-way, and in the towns 50-year franchises have been secured. It is of interest to note further that the company expects to mine its own coal.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—The Darlington Corporation is increasing the salary of Mr. Lunn, its electrical engineer, from £250 to £350.

Last Friday evening Mr. Sydney W. Baynes, chief electrical engineer, presided over a large gathering of the staff of the St. Pancras electrical department, at the Mother Red Cap, Camden Town, to present Mr. W. A. Brown, the distributing engineer, with an oak spirit cabinet on the occasion of his marriage.

A presentation has been made to Mr. J. W. Turner, chief electrical assistant, of Huddersfield, on his marriage, the staff and employés having given him a case of cutlery.

Mr. William Drysdale, chief assistant engineer, Corporation electricity works, Falkirk, has been appointed chief assistant electrical engineer for the borough of Weymouth and Melcombe Regis. There were 130 applicants. Mr. Drysdale has been at Falkirk for about two years.

Electric Tramway Officials.—Mr. H. N. Thomas, the retiring tramways manager at Huddersfield, was last week presented with a breakfast tureen and silver cigar case by the employés of the tramways department.

General.—On the occasion of his retiral on Friday last, Mr. Dumaresq, chief engineer to Messrs. Derry & Toms, Kensington, was presented by the staff with a combination smoking and spirit cabinet, as a token of their esteem and goodwill. He is to be succeeded by Mr. W. H. Sayer, late chief assistant.

Mr. Marshall Osborne, for a large number of years on the staff of the British Thomson-Houston Co., Ltd., electrical engineers and manufacturers, Rugby, has resigned his position with them to accept that of assistant manager of the Stirling Boiler Co., of Edinburgh and Motherwell. He carries with him to his new position the good wishes of a host of friends.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electric Calibrated Fuse Co., Ltd. (78,488).—Issue on August 29th of £550 5 per cent. debentures, part of series created December 4th, 1903, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Lang, 137, Fenchurch Street, E.C. No trustees. Previously issued of same series, £4,150.

Metropolitan Electric Supply Co., Ltd. (25,395).—A mortgage by sub-demise, dated August 5th, 1904, (supplemental to a trust deed dated July 20th, 1894, securing £250,000 first debenture stock), and a further mortgage by sub-demise, of even date, (supplemental to a trust deed dated July 4th, 1899, securing £250,000 second debenture stock), have been registered. Property charged in both cases: Freehold hereditaments Nos. 23—26, Fisher Street, and 63—66, Eagle Street, Holborn, comprised in registered title No. 82,208, and leasehold hereditaments in Tower Street, St. Giles-in-the-Fields, comprised in registered title No. 49,994. Trustees for first debenture stockholders: Sir R. G. W. Herbert, G.C.B., 3, Whitehall Court, S.W.; and Sir J. Pender, Bt., Donhead House, Salisbury. Trustees for second debenture stockholders: D. Meinertzhagen, 12, Tokenhouse Yard, E.C.; and Admiral J. Hay, G.C.B., Fulmer Place, Fulmer, Bucks.

Chili Telephone Co., Ltd. (29,252).—This company's annual return was filed on August 12th, when 44,000 shares had been taken up out of a nominal capital of £250,000 in 50,000 shares of £5 each. £220,000 has been received. Mortgages and charges: £35,000.

Crompton & Co., Ltd. (27,200).—This company's annual return was filed on August 27th, when 85,000 shares had been taken up out of a nominal capital of £300,000 in 100,000 shares of £3 each. £255,000 has been received. Mortgages and charges: £100,000.

ELECTRICITY SUPPLY ACCOUNTS.

Bridgend Municipal Electricity Accounts.

The accounts of the Bridgend Urban District Council's lighting undertaking are of more than usual interest, since that town has early taken advantage of a bulk supply of energy. One of the stations of the South Wales Electrical Power Distribution Co. has been built in Bridgend, and, the system being a two-phase one of 60 periods, the Council are able to retail electricity in that form, without the expense of conversion to continuous current. The present accounts cover the first 10½ months' working of the undertaking, and the Council may congratulate themselves on having already both satisfied all statutory capital charges, and in addition realised a surplus of £150—nearly 2½ per cent. upon the capital expenditure. Considering the small population (6,000), these results are very satisfactory. The price paid to the South Wales Co. for the bulk supply is 1·375d. per unit, while the company supplies current to power users in the area direct. The Council's tariff to private customers is 4½d. per unit.

General Statement for Year ending March 31st, 1904.

Capital expenditure	£6,154
Units sold :—	
Private lighting	36,182
Public lamps	37,782
Total	73,964
Equivalent number of 8-c.p. lamps connected ...	3,975
Number of public lamps	15 arc 184 inc.
Maximum observed load	90 kw.
Average price obtained :—	
Private lighting per unit	4·66d.
Public lighting „	2·80d.

Revenue Account.

		Per unit sold.
Gross revenue	£1,145	3·72d.

Works Cost, &c.

		Per unit sold.
Purchase of current in bulk, 77,040 B.T.U. at 1·375d.	£442	1·435d.
Distribution	20	·065d.
Public lamps	42	·136d.
Management	79	·256d.
Total working cost ...	£583	1·892d.

Profit Statement.

		Per cent. on capital expenditure.
Sinking fund	£174	2·83 per cent.
Interest on loans	238	3·87 „
Net profit (paid into district fund)	150	2·44 „
Gross Profit	£562	9·14 per cent.

ELECTRIC TRAMWAY ACCOUNTS.

Salford and Blackburn Municipal Tramways.

The returns of these Lancashire tramway undertakings are interesting from the several conditions under which they are working. The Salford system comprises 59½ miles of track, made up of 35½ miles owned by the Corporation, 5½ miles of Manchester track over which running powers are in force, 6½ miles leased from the Eccles authorities, 7 miles from Swinton and Pendlebury, 3¼ miles from Prestwich and 1¾ from Whitfield.

The long-delayed agreement with the Manchester authorities resulted in mutual interrunning facilities being arranged, and certain new routes are being constructed with a view to furthering this end. The traffic conditions are among the best, and the figure for working expenses, well below the average, taking into account the somewhat high average cost of energy (purchased from the Lighting Department and Manchester Corporation).

It will be noted that financial charges are partly replaced by rental of leased lines, and that a surplus of over £15,000 remains on the year's working. From the latter surplus the rates have benefited to the extent of £12,000, and the balance was placed to reserve and renewals. The manager of the Salford undertaking is Mr. Ernest Hatton.

The Blackburn system also extends beyond the limits of that borough, and the traffic conditions, as disclosed by the average earnings, are very satisfactory. Working expenses are somewhat above the average, the charges for energy alone approaching 3d. per car-mile, and the further financial charges are ruinously heavy (5·16d. per car-mile), and these latter handicap the concern; one-fourth of the financial charges being due to capital representing the purchase price of the old tramways company.

The result of the year's operations as shown, was a deficit of £5,000. The manager and engineer is Mr. A. S. Giles.

	Salford.	Blackburn.
For 12 months ending	Mar. 31, 1904.	Mar. 25, 1904.
Length of route	32 miles	14 miles
Total length of track	59½ „	24 „
Number of cars in use	—	48
Car-miles run	4,726,466	951,484
Passengers carried	36,956,405	7,742,692
Capital expended to date	£620,069	£320,203
Traffic receipts	£198,422	£43,374
Total „	£198,890	£44,682
Working expenses	£138,541	£29,369
Gross profit	£60,349	£15,313
Income per car-mile	10·09d.	11·27d.
Working expenses per car-mile ...	7·03d.	7·40d.
Interest and sinking fund per car-mile	1·73d.	5·16d.
Rent of lines	·55d.	—
Total expenses per car-mile	9·31d.	12·56d.
Profit or loss per car-mile	+·78d.	−1·29d.
Cost of energy per car-mile	2·42d.	2·81d.
Average fare per passenger	1·2d.	1·35d.
Revenue per mile of route	£6,215	£3,191
Expenditure per mile of route ...	£4,330	£2,097
Total units used	6,102,524	1,785,712
Units used per car-mile	1·29	1·88
Percentage of working ex'es to receipts	69·5 %	6·56 %

Profit Statement.

	Salford.	Blackburn.
Interest on loans	£17,835	£8,818
Sinking fund	16,171	11,633
Lease rentals	10,903	—
Surplus on year's working	15,440	−5,138
Gross profit	£60,349	£15,313

CITY NOTES.

Yorkshire Electric Power Co.

The half-yearly meeting of this company was held at the Hotel Metropole, Leeds, on Tuesday, August 30th, Mr. A. G. Lupton presiding.

In moving the adoption of the report, the Chairman said that the payments on account of contracts had not been called for quite so rapidly as they had anticipated, and as there was no use in drawing money from shareholders to lie in the bank, they had not made the call; but, so far as he could tell, the next call would fall due early in November. Since the first half-yearly meeting, held in September, 1903, the directors had had a busy and somewhat anxious time. The administrative expenses during the half-year were large. They had been swollen by law charges of an amount of over £900, and there was still a further amount which would have to come into the next balance-sheet. When their Act was drafted, clauses were included for the protection of local authorities, and the company could in no case, without the consent of the local authorities, go into those areas where the local authorities had obtained distributing powers, and compete with them. All the rights and privileges which these local authorities ought to have were amply protected, but, in spite of this, in several cases in this last session of Parliament, local authorities had been promoting Bills desiring to supply electricity outside their own areas, and to employ and risk the money of their ratepayers by entering into competition with this company. The directors had opposed these Bills, and the Committees of Parliament had, in every case where they fought the Bills, upheld the action of the directors of the company in a very decisive manner. They hoped that, now the company was getting to work, the local authorities would support them and make use of the company rather than spend their own money and the money of the company in fighting in that profitless manner. In regard to the progress made at Thornhill with the central supply station, the building was completed. The plant was being pushed on with as

rapidly as possible. The boilers were installed, and a quantity of the subsidiary plant was also there, and he believed that they would have the first generating set delivered either in September or October, and they would be in plenty of time to carry out their promise of supplying current this year. They had been carrying on negotiations with private consumers, and also with several local authorities, for supplying to them current in bulk for them to distribute for lighting and for power and other purposes in their districts. Under their agreement with the Urban District Council at Mirfield, the Council was to supply the current for lighting, and to do the general distribution in their district, but the larger users of electric power would come direct to the company. The local authority obtained its electricity at a very low cost, and it would be able to supply it for lighting and other purposes at similar prices to those which could be afforded in large towns and cities. The company had already arranged for routes for some 12 miles of cable. Further routes were being considered. They were going to supply the neighbourhood of the station first, and the more support they received, the more rapidly they would be able to extend these cable routes to other districts.

Mr. E. A. Carolan seconded the motion, and it was adopted.

The Electric Railway and Tramway Carriage Works, Ltd.

The directors' report, to be submitted to the annual meeting to be held at the offices, Strand Road, Preston, on Thursday, September 22nd, at 12 noon, reads:—

The directors herewith submit the balance sheet of the company's trading for the year ending June 30th, 1904. The works have been efficiently maintained as regards buildings and machinery, the cost of which has been charged against revenue. After paying debenture interest, amounting to £2,500, and charging £4,299 7s. for depreciation, the profit for the year is £5,546 3s. 4d., to which must be added £4,826 18s. 7d. brought from last year, making a total of £10,373 1s. 11d. The directors recommend that this amount be dealt with as follows:—

To pay a dividend of 5 per cent. less income-tax, for the year ending June 30th, 1904	£7,500	0	0
To carry forward to next year	2,873	1	11
Total	£10,373	1	11

Severe competition and general slackness of trade accounts for the falling off in the profits for the past year. In the opinion of the directors the prospect for the coming year have improved. In accordance with the articles of association, two directors retire, viz., Mr. Barningham and Mr. Kerr, and, being eligible, offer themselves for re-election.

The dividend last year was 8 per cent. on the ordinary shares, with a balance of £5,427 carried forward. The net profit for this year is £5,546, but as a payment of 5 per cent. on the ordinary shares of £150,000 requires £7,500, it will be seen that, but for last year's carry forward, the dividend would have been smaller still. The amount of the gross profit was £33,682 last year, and it has now dropped to £23,133. The net profit last year was £16,595. Sundry debtors stand at £78,037, against £68,735 last year. Sundry creditors and outstanding accounts, including bills payable, have increased from £20,223 to £25,152. The amount put to depreciation is only £4,299, against £5,096 last year. It is satisfactory to note, from the directors' statement, that things are improving. We most sincerely trust that they are; but, unless there were a sudden and remarkable boom—which is hardly expected, though there are not wanting signs of some awakening—the company can hardly get back to its 8 per cent. dividend again next year.

Northampton Electric Light and Power Co.—The directors, in the course of a circular issued to-day to the shareholders, state:—"The directors are glad to be able to report that the progress of the undertaking is entirely satisfactory, notwithstanding the somewhat depressed condition of trade in the town. They feel, therefore, in a position to pay an interim dividend for the first time on the ordinary shares for the half-year ended June 30th at the rate of 4½ per cent. per annum. The usual half-yearly dividends on the 6 per cent. and 5 per cent. preference shares are also now paid. The cost of fuel and the other working expenses are even less per unit than for last year, and this reflects great credit on the chief engineer and his staff."

General Electric Co.—The transfer books of the 4 per cent. debenture stock will be closed from 17th to 30th inst. both, days inclusive.

Lanarkshire Tramways Co.—On August 31st Mr. A. R. Monks presided over a meeting of this company held at 83, Canron Street, E.C. He said that the report was highly satisfactory, and they were carrying forward a considerable amount to the next account. No doubt on the next occasion the dividend would be equal to, and perhaps a great deal better than, the present one. A dividend at the rate of 4½ per cent. per annum was approved, a balance of £2,042 2s. 2d. being carried forward.

Prospectus.—*Tyneside Trawways and Tramroads Co.* The list opened on Wednesday last week, and will close to-morrow (Saturday), of an issue of £40,000 5 per cent. mortgage debentures (£50), part of a total issue of £65,000, which will constitute a first charge on the undertaking.

South Metropolitan Electric Light and Power Co.—The transfer register of 4½ per cent. first mortgage debenture stock will be closed, as from the 17th to the 30th inst., for the purpose of preparing interest warrants for the above stock, payable October 1st, 1904.

Stock Exchange Notice.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—London Electric Supply Corporation, Ltd.—Further issue of 10,000 6 per cent. preference shares of £5 each, fully paid.

STOCKS AND SHARES.

Wednesday Evening.

To be able to chronicle cheerfulness in Stock Exchange markets for two consecutive weeks is too unusual an event for it to be passed by unrecognised. The liberal supply of floating money which remains on offer is one good feature, although the regular autumn rise in the Bank Rate may still put in its appearance. Talk of hardly-expected mediation between the Far Eastern belligerents perhaps tended to induce more confidence; and while no department in the Stock Exchange has much to brag about at present so far as orders go, the volume of business certainly begins to expand. Electrical securities have few changes to show, and what there are seem to be pretty evenly divided between rises and falls. The only department in which a marked change has taken place is the Anglo-American Telegraph group, where prices spurted sharply.

Railway stocks are erratic in tone. Central London Ordinary has fallen a point to 87, while Districts at 39 are 1 per cent. harder, and Metropolitans rose 1½ to 95. Proprietors of the "Twopenny Tube" stocks continue to be much exercised in their minds as to the effect the electrified District will have upon the traffics of their undertaking. Expert views are constantly being sought in the market, but since the matter after all is one in which one man's judgement is as good as another, opinions vary widely. Unfortunately for the Central London, its traffic has recently suffered from reasons far removed from any point connected with electrical competition, but the crumbling of the quotations causes holders to become more apprehensive of the coming rivalry than they might otherwise be.

Great Northern and City Preferred are steady at 4¾; City and South London has risen 2 points to 43, while Waterloo and City is not a good market at 87½. British Columbia Electric Railway Deferred and Preferred are 98½ and 101½ respectively, the sentimental effect of the recent fire being still apparent in the price of the former stock.

In the Traction section, City of Buenos Ayres Trams have firmed up to 10¼, and there is a good deal doing in the shares. Anglo-Argentine Tramways Ordinary at 6¼, and the Preference at 5½, are about the same as they were last week. Barcelona Trams have been dealt in at 9⅝, and the Preference are 10¼ to 11. There is a slight rise in London United Preference, at 10¾; the Debenture remains quiet at 104.

Thanks to the reasons detailed in these columns a fortnight ago, Anglo-American Telegraph stocks have come strongly into favour. The Preferred is no less than 6 points better, at 97, after being 98, and the Ordinary rose 4, to 52½. Another 10s. rise has taken the Deferred to 8½. In this latter a fair amount of speculation has sprung up. It is stated that the company is now doing much better, but beyond this somewhat vague suggestion, there is no real information to justify the advance. Reactions in the prices may not be inevitable, but it looks as though they are quite likely to take place as the recent buyers come forward to secure their profits. Except for this, the Telegraph market is uninteresting, no other changes having occurred. Eastern issues should benefit by the unhappy chance of the war being further prolonged by the present happenings in the Extreme East, which make mediation look farther away than ever. Commercial Cables and Submarine Cables Trust are unmoved by the jump in the quotations of the Anglo-American varieties, nor have Globes of either sort moved from their previous prices.

Electric Lighting shares are almost as bad in their immobility as Telegraph descriptions. County Preference at 11⅜ have put on ¼, and there is a 2 per cent. rise in South Metropolitan Electric Debenture stock. It may be parenthetically wondered how much longer the *Stock Exchange Official List* will continue to quote this latter company under its old, discarded name. Oxfords are still nominally 6, *cum* rights in the issue of 2,000 new shares now being made to proprietors, at £5 per share. It is, however, hardly likely that the market will accommodatingly buy old shares at 6 in order that shareholders may take up the new issue at 5, although, of course, there is a difference of dividend in the new kind, which works out to about $\frac{5}{16}$ in favour of the old. Bournemouth and Poole are 12 and 10 for Ordinary and Preference, Bromley 5¾, and Hove shares 8. The provincial market has been exceedingly quiet for a long time past. Calcutta Electrics are 7½, and Havana Electrics about 10. British Electric Traction First Debenture at 118½ is a trifle better.

As regards Miscellaneous issues, Telegraph Construction shares are £1 up at 37½, partly because of the strength lately shown by the Telegraph market. National Telephones continue to be quietly absorbed. The Deferred shows a couple of points improvement at 92½, and the new Debenture has moved up to 67 middle; Westinghouse Preference and Debenture at 3 and 86½ have been standing at these prices for the past fortnight.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Aug. 31st.	Closing Quotations Sept. 7th.	Business done week ended Sept. 7th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	..	..	..	— —	— —	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	47 — 50	51 — 54	51⅜	48½
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	90 — 93	96 — 98	98½	91½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7⅞— 8½	8¼— 8⅝	8⅝	8
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5½	5 — 5½	..	..
18,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	95	94⅛
16,000	Cuba Telegraph	10	4 %	5⅓%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,931	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101⅝	98 —101 ⅝	..	..
60,710£	Direct United States Cable	20	8⅛%	8⅛%	8 %	10 — 10½	10 — 10½	10⅛	10⅛
61,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	126 —131	126 —131	129	128½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89½	88½
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅛	12⅛
820,000£	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106	103 —106	106	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5⅓%	8⅞— 9½	8⅞— 9½	9⅛	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 14	13½— 14½	14⅛	13½
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	25½— 26½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	43 — 46	43 — 46	..	..
1,988,888	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105½	104½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	89 — 92	91 — 94	92	90
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	12⅞	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅛	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98½	98⅛
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	105	..
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	65 — 67	65 — 68	66⅞	66½
179,318	Oriental Telephone and Elec. Nos. 1 to 171,604, fully paid	1	6 %	6 %	6½%	⅞— 1⅛	⅞— 1⅛	1	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7½	6½— 7½	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6½	6⅝	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brss. Sub. Tel.	100	..	..	..	97 —100	97 — 100	..	..
367,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅜	12⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	101	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —103	100 —103	101¼	101
88,321	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6¾	6½— 6¾	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8½— 9½	8½— 9½	9½	9
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10½— 11	10½— 11	10⅞	10¹¹⁄₁₆
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	117 —120	118½	..
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	94 — 97	96	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅝— 6⅛	5⅝— 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6⅛— 6	5⅞— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅝— ¹¹⁄₁₆	⅝— ¹¹⁄₁₆	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1½	1 — 1½	1⅛	1⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97 xd	94 — 97 xd	..	..
'25,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10½	9½— 10½	10⅛	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	87 — 89	86 — 88	87½	86½
494,088	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 — 102	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	80 — 82	80 — 84	..	..
1,980,000	City and South London Railway	Stock	2 %	3½%	2¾%	40 — 42	42 — 44	43½	41½
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1⅞— 2	1⅞— 2	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
12,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2 — 2½	2 — 2½	2⅜	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	9⅜	9½
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11 — 12	11 — 12	11⅜	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛xd	5 — 5⅛xd	5⅛	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111 xd	107 —111 xd	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18⅜— 19½	18⅜— 19½	..	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
97,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3½— 3⅝	3½— 3⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,850	Telegraph Construction and Maintenance.	12	20 %	20 %	20 %	35 — 38	34 — 37	35	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	86 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years			Closing Quotations Aug. 31st.	Closing Quotations Sept. 7th.	Business done week ended Sept. 7th, 1904.	
		‡	1901.	1902.	1903.			Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£5	8%	8 %	10 %	10¾ — 11¼	10¾ — 11¼	11¼	11
20,000	Do. do. 7 % Cum. Pref. ..	£5	..	..	..	10¼ — 10¾	10¼ — 10¾	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	..	..	..	106 —109	106 —109	..	..
60,000	Charing Cross and Strand Electricity Supply	£5	10 %	10 %	8 %	7¾ — 8¼	7¾ — 8¼	8 3/32	..
70,000	Do. do. 4½% Cum. Pref. ..	£5	..	..	..	5¼ — 5⅝	5¼ — 5⅝	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£5	..	..	..	4¾ — 5	4¾ — 5	4 13/16	..
40 000	Do. do. 1903	£5	..	..	..	4¾ — 5	4¾ — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	£100	..	..	..	102 —104	102 —104	..	..
44,486	*Chelsea Electricity Supply, Ord.	£5	4 %	4½%	5½%	6½ — 7	6¾ — 7	6¾	6 1/16
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£10	5 %	5 %	5 %	10¼ — 10¾	10¼ — 10¾	10 13/16	10¾
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	120 —125	120 —125	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	£100	..	..	..	102 —105	102 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4 %	7½ — 8¼	7¾ — 8¼	8¼	8¼
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	£10	..	..	..	11 — 12	11¼ — 12	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	7 %	6 — 6¼	6 — 6¼	6 3/16	6 1/16
80,000	Do. do. 6 % Cum. Pref.	£10	..	..	..	6 — 6½	6 — 6½	6 5/32	6 1/16
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	£100	..	..	..	104 —107	104 —107	105	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	10 %	12½%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£5	..	..	..	1¾ — 2	1¾ — 2	..	..
49,840	Do. do. do. 6 % Pref.	£5	..	..	..	5 — 5¼ xd	5 — 5¼ xd	5¼	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	97¼	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£10	6¼%	7½%	8¾%	15¼ — 16¾	15¼ — 16¼	16 7/16	16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£5	..	..	..	5¾ — 5⅞	5⅝ — 5⅝	5¾	5 13/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,882	Notting Hill Electric Lighting	£10	6 %	6 %	6 %	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	14½ — 15½	14½ — 15½	..	..
30,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	£100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	..	2½%	4 %	2¾ — 3¼	2¾ — 3¼	..	..
50,000	Do. do. 4 % Deb. Stock	Stock	..	..	..	88 — 88	83 — 88	..	..
65,000	South London Electricity Supply, Ord.	£5	..	1½%	3 %	3¾ — 4¼	3¾ — 4¼	4 3/32	4¼
100,000	South Metropolitan Electric Light and Power, Ord.	£1	..	..	..	¾ — 1	¾ — 1	..	..
50,000	Do. 7 % Pref.	£1	..	..	..	1¼ — 1⅜ xd	1¼ — 1⅜ xd	..	..
100,000	Do. 4½% 1st Deb. Stock	£100	..	..	..	103 —107	105 —109	107	..
30,000	Urban Electric Supply, Ord.	£5	..	..	..	4¾ — 5¼	4¾ — 5¼	4 3/32	..
80,000	Do. do. 5 % Cum. Pref.	£5	..	..	..	4¾ — 5¼	4¾ — 5¼	..	..
110,000	Westminster Electric Supply, Ord.	£5	10½%	12 %	13½%	12¾ — 13¼	12¾ — 13¼	13 1/4	12 3/8
28,141	Do. do. 5 % Cum. Pref.	£5	..	..	..	6 — 6¼	6 — 6¼	6 5/32	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 7th.

	CHEMICALS, &c.	Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric .. .. per cwt.	5/-	..
a	" Nitric .. .. .. per cwt.	22/-	..
a	" Oxalic .. .. .. per cwt.	82/-	..
a	" Sulphuric .. .. .. per cwt.	5/6	..
a	Ammoniac, Sal .. .. per cwt.	42/-	..
a	Ammonia, Muriate (crystal) .. per ton	£33 10	..
a	" " .. .. .. per ton	£30	..
a	Bleaching powder .. .. .. per ton	£4 10	..
a	Bisulphide of Carbon .. .. per ton	£15	..
a	Borax .. .. per ton	£13	..
a	Benzole (90 %) .. .. .. per gal.	7/-	..
a	" (50/90 %) .. .. .. per gal.	5/6	..
a	Copper Sulphate .. .. .. per ton	£19	..
a	Lead, Nitrate .. .. .. per ton	£30	..
a	" White Sugar .. .. .. per ton	£31	..
a	" Peroxide .. .. .. per ton	£27 10	..
a	Methylated Spirit .. .. .. per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C). per gal.	5/6	..
a	Potash, Bichromate, in casks .. per lb.	8d.	..
a	" Caustic (75/80%).. .. per ton	£24	..
a	Shellac .. .. per cwt.	210/-	..
a	Sulphate of Magnesia .. .. per ton	£4 10	..
a	Sulphur, Sublimed Flowers .. per ton	£6 10	..
a	" Recovered .. .. per ton	£5 10	..
a	" Lump .. .. .. per ton	£5	..
a	Soda, Caustic (white 70 %) .. per ton	£10 15	..
a	" Crystals .. .. .. per ton	£8	..
a	" Bichromate, casks.. .. per lb.	2½d.	..

	METALS, &c.		
b	Aluminium Ingots, in ton lots .. per ton	£180	..
b	" Wire, in ton lots .. per ton	£168	..
b	" Sheet, in ton lots .. per ton	£166	..
b	Babbitt's metal ingots .. .. per ton	£43 to £130	..
c	Brass (rolled metal 2" to 12") basis per lb.	6¾d.	..
c	" Tube (brazed) .. .. per lb.	7¼a.	..
c	" " (solid drawn).. .. per lb.	7¼d.	..
c	" Wire, basis.. .. .. per lb.	6¾d.	..
c	Copper Tubes (brazed) .. .. per lb.	9½d.	..
c	" " (solid drawn) .. per lb.	9¼d.	..
c	Copper Bars (best selected .. per ton	£70	..

	METALS, &c. (continued).	Latest Price.	Week's Dec. or Inc.
g	Copper Sheet .. .. .. per ton	£70	..
g	" Rod .. .. .. per ton	£70	..
e	" (Electrolytic) Bars .. per ton	£62	..
e	" " Sheets .. per ton	£78	..
e	" Rod .. .. per ton	£72	..
e	" H.C. Wire per lb.	7¾d.	..
f	Ebonite Rod .. .. .. per lb.	3/8	..
f	" Sheet .. .. .. per lb.	8/-	..
n	German Silver Wire .. .. per lb.	1/6	..
h	Gutta-percha fine .. .. .. per lb.	8/-	..
h	India-rubber, Para fine .. .. per lb.	4/11 to 5/-	..
i	Iron, Charcoal Sheets .. .. per ton	£18	..
i	" Pig (Cleveland warrants) per ton	43/3	6d. inc.
i	" Forgings, according to size per ton	From £11	..
i	" Scrap, heavy .. .. per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 .. per ton	£9 15	..
g	Lead, English Ingot .. .. per ton	£12	..
g	" " Sheet .. .. per ton	£11 17s. 6d.	..
m	Manganin Wire No. 28 .. .. per lb.	8/-	..
g	Mercury .. .. per bot.	£7 15	..
d	Mica (in original cases) small .. per lb.	6d. to 1/	..
d	" " " medium per lb.	2/6 to 4/-	..
d	" " " large .. per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings per lb.	1/- to 1/2½	..
p	" rolled bars & rods per lb.	1/- to 1/3	..
p	" " strip & sheet per lb.	From 1/1	..
o	Platinum .. .. per oz.	£4	..
c	Silicium Bronze Wire .. .. per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n per ton	£68	..
i	" " in bars	£15 to £40	..
g	Tin, Block .. .. per ton	£127 10 to £128 10	£2 inc.
g	" Foil .. .. per lb.	1/6	..
n	" Wire, Nos. 1 to 16 .. .. per lb.	1/6½	½d. dec.
p	White Anti-friction Metals—		
	"White Ant" brand .. per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls per lb.	8d.	..
j	" 6 lea. Flax .. .. .. per lb.	5¾d.	..
j	" 8 ply 10 lbs. Russian .. per lb.	4½d.	..
j	" 10 lbs. Russian, single .. per lb.	4¼d.	..
j	" 180 lbs. Jute rove .. per ton	£11	..
k	Zinc, Sh'ts (Vieille Montagne brd.) per ton	£25 5	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co.; f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

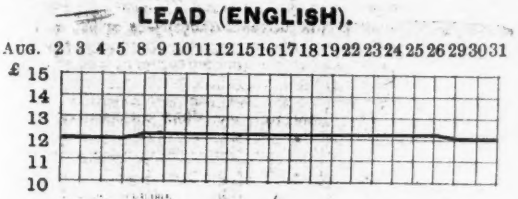
	Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
			£	£*		£	£*		*
Tram.	Aberdeen	Sep. 3	1,667	+355	14	23,213	+ 4,457	10	—
	Bath	Aug. 31	804	—	36	22,286	—	12½	—
	Birmingham ..	Sep. 3	5,179	— 22	36	193,263	+11,379	32	—
	Blackburn	" 2	1,026	+236	22	22,587	+ 2,336	13½	—
	Blackpool	" 1	2,231	+ 618	21	20,892	+ 4,103	8½	—
	" —Fleetw'd	" 3	1,164	+ 95	9	14,046	— 40	7½	—
	" —Lytham	" 1	902	+ 207	44	16,747	+ 6,855	7½	—
	Bolton	" 4	1,842	— 71	23	43,645	+ 271	25	—
	Bournemouth ..	Aug. 31	1,465	+ 26	23	26,567	—	10½	—
	Bradford	" 27	4,458	+602	21	101,322	+17,628	50	—
	Brighton	Sep. 4	1,280	+173	—	25,182	—	9	—
	Bristol	" 2	5,494	+295	—	—	—	28	—
	Devonport ..	Aug. 26	629	+147	34	18,810	+ 3,088	5	—
	Dudley—Sto'rb'ge	" 26	915	+ 7	34	29,756	+ 1,155	18½	—
	Gateshead ..	" 26	930	— 24	34	30,863	+ 1,349	10½	+ ½
	Gr'n'k—Pt. Glsgw	" 26	658	— 15	34	19,557	+ 987	7½	—
	Oldham—Ashton	" 26	646	+ 86	34	18,766	— 490	8	—
Elec.	Potteries	" 26	1,595	+ 16	34	57,869	+ 4,938	28½	—
	South Staffs. ..	" 25	795	—371	34	26,309	— 3,928	21½	—½
	Swansea	" 26	610	+ 8	34	18,888	+ 1,011	5½	—
&	Wolverhampton..	" 26	424	— 4	34	13,391	— 91	10½	+8
Mot.	Yorks. Wool Dist.	" 25	592	+ 95	34	20,432	+ 8,161	6	—
	Miscellaneous ..	" 26	4,932	—	34	122,677	—	—	—
Rly.	Burnley	Sep. 3	1,117	+273	—	—	—	10½	+2½
	Burton-on-Trent ..	" 4	383	— 11	22½	8,253	—	8½	—
	Cardiff	Aug. 20	2,189	+101	20	43,465	+ 1,876	14	—
	Chatham & District	Sep. 1	671	— 64	35	20,799	+ 2,157	8·88	—
	Cork	" 1	568	— 66	35	16,458	— 2,128	9·69	—
	Dover	" 3	985	— 25	35	7,812	— 248	8	—

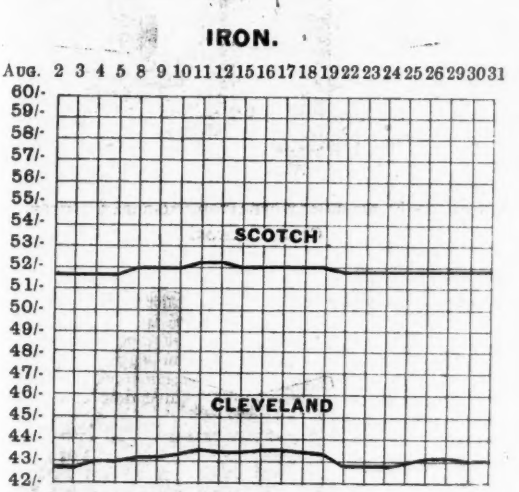
	Locality.	Week ending	Receipts for the week.		No. wks.	Total to date.		Miles open.	
			£	£*		£	£*		*
	Dublin	Sep. 2	5,792	+ 287	—	52,047	— 3,117	47	+ ½
	East Ham	" 3	748	— 11	22	17,435	+ 1,871	5	+ ½
	Glasgow	" 3	15,026	+1401	15	195,769	+12,508	71½	+5½
	Halifax (2 weeks) ..	Aug. 24	3,258	+174	21	33,655	+ 2,460	33	+1½
	Huddersfield ..	Sep. 3	1,469	+268	22	—	—	28	—
	Hull	" 3	2,300	+458	23	48,727	+ 6,658	13	+2½
	Ilkeston	Aug. 31	170	— 22	22	3,349	—	3·5	—
	Ipswich	Sep. 3	617	—	22	12,250	—	10½	—
	Isle of Thanet ..	" 3	1,618	+110	35	26,591	+ 1,184	10½	—
	Leeds	" 6	6,290	+961	—	137,737	+ 8,788	81½	+2
	Liverpool	Aug. 27	10,411	+ 11	35	361,869	+11,785	103	—
	London C. C. ..	Sep. 3	13,709	+2977	22	284,181	+58,026	462	+6½
	Manchester	Aug. 27	12,485	+804	21	263,797	+10,377	137½	+12½
	Newcastle	Sep. 3	3,655	+261	—	—	—	17	—
	Portsmouth	Aug. 27	2,578	+200	—	47,038	+ 4,188	14½	—
	Salford	" 29	4,295	+460	—	90,078	+ 6,769	30	—
	Sheffield	Sep. 4	4,810	+107	23	110,005	+ 2,675	33	+5½
	Southampton ..	" 1	1,115	— 64	—	—	—	9	—
	Southend-on-Sea ..	Aug. 31	599	+ 59	22	9,497	+ 1,133	6½	—
	Sunderland	Sep. 4	1,388	+ 13	22	30,282	+ 720	21	+1
	Tyneside	Aug. 31	448	+ 89	35	13,565	+ 2,138	8·9	+·4
	West Ham	Sep. 1	1,212	—	27	23,870	—	8·62	—
	Wolverhampton ..	Aug. 24	748	+282	—	—	—	9·5	—
	Cen. London Rly. ..	Sep. 3	5,604	+109	9	52,182	— 1,957	6	—
	City & S. Lon. Rly.	" 4	2,430	+ 24	10	23,205	— 1,067	6½	—
	Dublin—Lucan Rly.	" 2	158	— 8	9	1,358	+ 24	6½	—
	G. N. and City Ry.	Aug. 27	1,010	—	28	26,814	—	3½	—
	L'pool Overh'd Rly.	Sep. 4	1,594	—120	10	16,983	— 271	6½	+4½
	Mersey Railway ..	" 3	1 406	+148	9	12.922	+ 846	4½	—

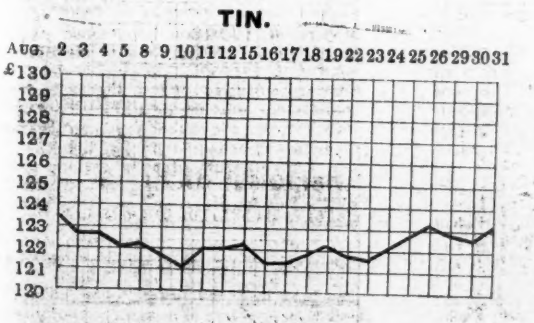
* Compared with the corresponding period of 1903.

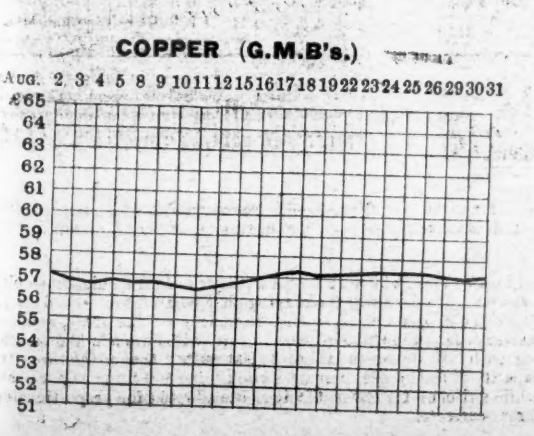
METAL MARKET.

Fluctuations in August.









STEAM TRIALS ON WILLANS CONSTANT THRUST ENGINES.

(1) At Poplar Electricity Works.

On April 5th steam trials were made at the Poplar Vestry Electricity Works, where Mr. P. N. Hooper is the chief electrical engineer, on one of the 500 KW. Willans engines recently installed, with a view to ascertaining the commercial efficiency of the Willans-Mather & Platt steam sets under working conditions.

The trials were carried out under the supervision of Mr. P. N. Hooper by representatives of Messrs. Willans & Robinson, Ltd., and Messrs. Mather & Platt, and are of considerable interest at the present time, as showing the results obtainable with this type of engine under working conditions with only a moderate amount of superheat and with a comparatively poor vacuum. It will be noticed that at full load, with a vacuum of 25 in. in the engine, and with 25° of superheat only, a total steam consumption of 18·64 lbs. per KW. was obtained on one trial, and 19·52 lbs. of steam per KW. on a second trial.

This means that the mean of the two trials was about 19 lbs. of steam per KW., or about 11½ lbs. of steam per I.H.P. It will be conceded that these results are very good, considering the conditions. It is unnecessary to emphasise the fact that with higher degrees of superheat the steam consumption would have been considerably lower, as this engine benefits to an abnormal extent by the addition of superheated steam. The exhaust steam from the engines was collected and condensed in a tank mounted on a weighbridge, which was measured at definite periods.

The electrical instruments recording the output of the dynamo were of the Weston standard type, and were calibrated by an independent authority after the tests. The results in the tables herewith are corrected to allow for an error in the instruments which were found on calibration to be reading rather high.

Poplar Trials.

Conditions.	Steam pressure in Boiler.	Steam pressure in Steam chest.	Temp. in steam chest.	Degree of superheat.	Vacuum in engine.	Speed r.p.m.	Output. I.H.P.	Output. B.H.P.	Output. KW.
			Fah.	Fah.					
Full load	1f0	165	398°	25 1°	25″	260 3	825·8	672·6	501
¾ „	180	133	403°	51°	25″	266	653·2	512	381
½ „	180	88	402°	72°	26″	272	458·2	338	252

—	Guaranteed lbs.	Full load. 1st trial. Obtained lbs.	Full load. 2nd trial. Obtained lbs.	¾ load. Obtained lbs.	½ load. Obtained lbs.
Water per I.H.P.	—	11·33	11·80	12·1	12·46
„ „ E.H.P.	10	13·90	14·55	15·46	16·85
„ „ KW. ...	—	18·64	19·53	20·72	22·63

(2) At Blackburn Electricity Works.

On May 14th, 1904, similar tests were carried out at the Blackburn Corporation Electricity Works, where Mr. A. S. Giles is the chief electrical engineer. The tests were made with a view to ascertaining the commercial efficiency of the 750-KW. Willans steam dynamos recently installed in conjunction with Dick, Kerr & Co.'s 10-pole continuous current machine giving an output of approximately 1,600 amperes at 500 volts when running at a speed of 160 revs. per minute.

The trial under consideration at the present time was made on engine No. 3,416 by representatives of Messrs. Willans & Robinson and Messrs. Dick, Kerr & Co., under the direct supervision of Mr. Giles.

The steam consumption results, which are given herewith, are the mean results of three separate trials, which, considering the poor

Blackburn Trials.

Result of Three Trials on 750 KW. 3-V. Willans Engine, No. 3,416.

Steam pressure in boilers.	Temperature of steam at Boiler pres.	Temperature of steam at Stop valve.	Degree of superheat.	Vacuum.	Mean KW.	Water per I.H.P.	Water per E.H.P.	Water per KW.
179·6 lbs	379° F.	491° F.	112° F.	22″	775·2	11·05	13·7	18·34

vacuum prevailing, viz., 22″, and the moderate degree of superheat, viz., 112° F., are distinctly good, being 18·34 lbs. per KW., say, 11·05 lbs. per I.H.P. The steam consumption was obtained by measuring the water into the boilers, the tank used, which belonged to the station, being calibrated before the trial against a properly calibrated tank.

The instruments were of the Weston type, calibrated against standards before and after the trial.

At the present time engineers are interesting themselves to a considerable extent in results which are being promised with steam turbines, and consequently the two results given above will be of interest as showing what is possible with reciprocating engines, even in the smaller sizes.

THE WESTINGHOUSE OIL SWITCHES FOR HIGH-TENSION CIRCUITS.

We illustrate herewith a high-tension switch which may be operated electrically by sending low-voltage currents through one or the other of two solenoid and plunger systems; the effect of the one being to bring the high-tension contacts together, and that of the other to separate them. Matters can also be so arranged that any excess current in the high-tension circuit will actuate the solenoid switch, and so throw the main switch off, and the appliance then becomes a circuit-breaker as well. Indeed, owing to its electrical operation the apparatus may be made to switch on automatically when the full voltage is attained, and to switch off with reverse current or excess-current operation, and neither of these will interfere with its being worked by hand.

A three-phase switch is shown in its "open" position in fig. 1, and it will be obvious that a switch may be made with any required number of poles. The construction is briefly as follows:—The fixed contacts consists of slotted sockets mounted in cylindrical porcelain insulators, short pieces of insulated copper rod being let in at the currogated top ends of these insulators and secured to the sockets. These pieces of rod are bent at right angles, and are fitted with sweating sockets to take the ends of the main cables. Each pair of insulators is mounted on and "babbitted" into a cast-iron frame, which, in its turn is supported on special insulators from the underside of a slate or stone slab. This frame also acts as a support for the oil chambers, as will be described later on in connection with fig. 3. The moving contacts consist of a couple of conical plugs mounted at the ends of a copper cross-bar, the latter being carried on the extremity of a stout wooden rod. In the present case there are three such rods, which are fixed respectively at each end and at the middle of a cast-iron cross-arm, which serves to keep them the proper distance apart. When this cross-arm is raised, it brings the movable and fixed switch contacts together. The middle of the cross-arm is pivoted to the end of a double-armed lever, which, in its turn, is hinged to the end of a second lever, which rocks on a pivot secured to the cast-iron base on which all the upper parts of the mechanism are mounted. This base is fitted on the top of a thick slate or stone slab. Pivoted to the sides of the central iron support is another double-armed lever, the long ends of which are joined to the middle of the first-mentioned double-armed lever. The short ends of this lever are quadrant-shaped, and each supports a stout iron core hanging in the hollow of an ironclad solenoid. If, when the mechanism is in the position shown in the figure, a current be sent through the two solenoids, it will be evident that the cores will be sucked down into the latter, and that the whole system of levers will be actuated in such a way as to bring the cross-arm up to its topmost position and the switch contacts together. The action is such that the end of the stroke is completed very smartly, so that there is no doubt about the full engagement of the switch contacts. A short but strong helical spring at the top of the fixed support serves as a buffer to take the upward blow of the cross-arm; and the whole system when raised is held up by two links which form a stiff and rigid toggle, thus doing away with the necessity for keeping on the current in the solenoids. There is clearly no limit to the dimensions of the break, and, as a matter of fact, the standard sizes of this switch are adapted to dealing with all pressures up to 22,000 volts; the current-carrying capacity of the highest pressure switch being 100 amperes per phase, while switches for lower tensions are adapted for proportionately larger currents.

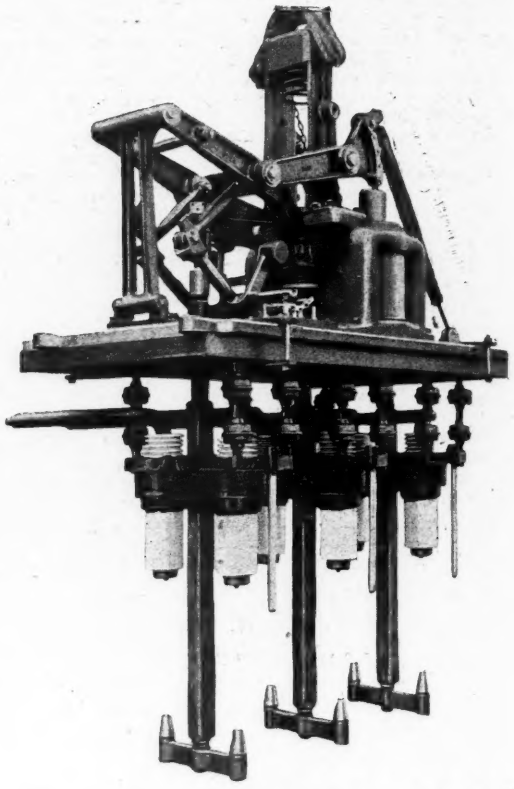


Fig. 1.—Electrically-operated Oil-break Switch. Open Position.

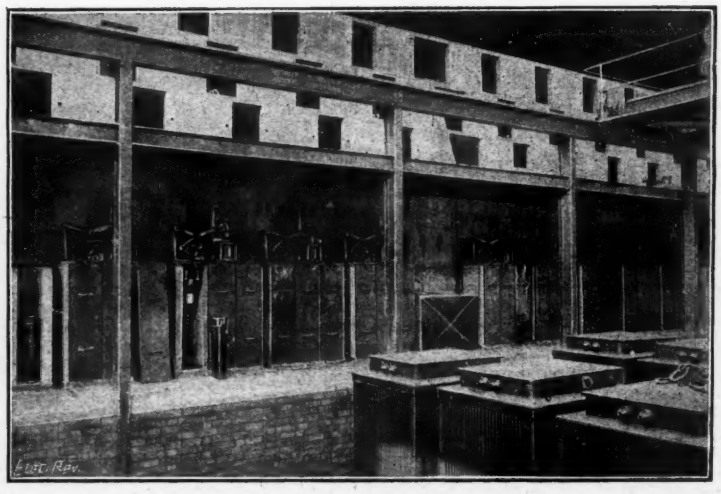


Fig. 2.—A Row of Electrically-Operated Oil-Break Switches, as Fitted in the Sub-Stations of the Electrified Section of the North-Eastern Railway.

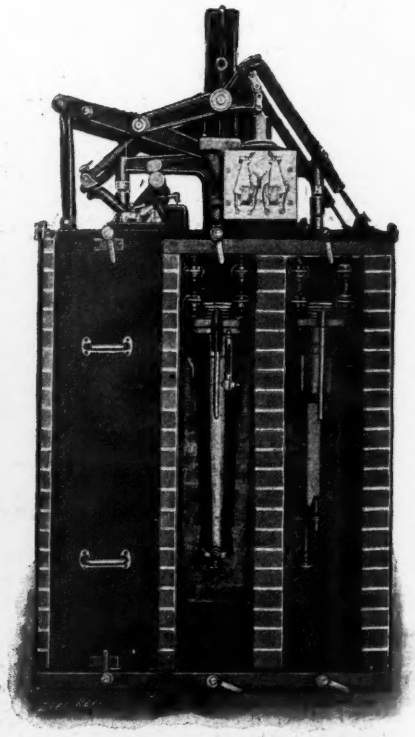


Fig. 3.—Method of Fixing Electrically-Operated Oil-break Switch.

The switch being closed, a tap with a hammer on the lower links of the toggle joints mentioned above, would break the support and allow the levers and cross-arm to fall by gravity, and so open the switch; the shock of the fall being eased by the short helical spring at the bottom of the central support and by the two long springs attached to the ends of the quadrant levers. The "knocking off" of the switch, however, is effected electro-mechanically in the following way:—Pivoted to a support on the base is a short cross-bar with three arms, two of which point upwards and terminate in hammer heads, while the other is almost horizontal and has a core limited to it, this core hanging down inside a small solenoid and below its centre. Thus, when the solenoid is energised the core is sucked *upwards*, and the hammers are thereby made to strike the link supports, and so cause the switch mechanism to fall to the "off" or "open" position. These hammer heads can be best seen in fig. 1, and in both figures it will be noticed that the lower parts of the link supports have counterweights attached to them.

Current for operating the solenoids may be derived from the station exciter circuits, from secondary coils, or, if need be, from a primary battery. Their windings may be arranged to suit the available pressure, the usual practice being to wind for a pressure of 125 volts. The two large solenoids are connected in parallel, and the actuating switch is a two-way one with "off" position, which sends the current either through the pair of pulling-on solenoids or else through the release solenoid. When once the switch is closed or opened it is not necessary to keep the actuating current on. Projecting from one of the link support counterweight arms is a stout pin which works a rocker attached to a small two-way switch fixed just in front (fig. 1), this switch being connected to operate an "on" and "off" indicator fixed on the distant switchboard, and so show at a glance the position of the high-tension switch. This arrangement generally takes the form of a lamp and an electro-magnetic indicator connected in parallel, the former serving to show the position of the switch at a distance, and the latter acting as a check upon the lamp in case of the breakage of the latter.

It is obvious that the main switch may be fixed at any distance from the actuating two-way switch and the indicator, which are generally fitted adjacent to one another; and it is also clear that the actual operating switchboard will be of the lightest possible description, and perfectly safe to handle. Fig. 2, for example, shows a number of these switches as fitted up in the sub-stations of the recently electrified section of the North-Eastern Railway; a bank of Westinghouse transformers being seen in the foreground.

In regard to the method of isolating the poles of the switch, and the oil immersion of the switch contacts, the details of this are shown in fig. 3, where it will be seen that each pole of the switch is contained in a separate fireproof brick chamber with removable fireproof door. Further, each set of pole contacts is closed in by a stout galvanised iron oil chamber, the interior of which is thickly lined with cement in such a way that there is just room for the switch beam and cross contact arm to pass up and down, the former effectually separating the two sockets when the circuit is broken.

Fig. 3 shows one pair of switch contacts enclosed in the oil chamber, and the other with the oil chamber removed; the method of fixing being such as to enable it to be unshipped with little trouble. The oil chambers are provided with oil-level indicators, and with outlets for emptying them. The short lengths of rod which have already been mentioned as passing out of the top of the switch socket insulators are carried through special insulators let in the wall of the brick chamber, and the connection with the mains is made outside. An overload release relay is shown fitted to the front of the switch-mechanism in fig. 3, but it is now usual to fix such devices on the operating switchboard.

The dimensions of a switch fitted up complete, as depicted in fig. 3, are approximately as follows:—Height from floor level overall, 7 ft. 8 in.; overall width of the set of three chambers and brickwork, 4 ft. 1 in.; internal height of brick chambers, 4 ft. 6 in.; internal depth of brick chambers, front to back, 1 ft. 10 in.

THE BUSINESS SIDE OF ENGINEERING.*

By ALEXANDER C. HUMPHREYS, President of Steven's Institute.

The engineer, to be practical, must be trained in business methods. The use of the word practical in qualifying the word engineer should be considered redundant. It should be understood that a man is not an engineer unless he is practical. But, unfortunately, the use of the word in this connection is found to be necessary. It is again unfortunate that the word practical, as thus used, is not always employed in the same sense. Sometimes it is used to distinguish between the rule-of-thumb engineers and the educated engineers who may be practical in fact; and sometimes it is used to distinguish between two classes of educated engineers, those able to practically apply what they know, and those who cannot render effective what they do know. . . . The man who is qualified in pure science, but has not had the experience to enable him to put his knowledge into efficient practice, cannot claim to be an engineer. On the other hand, the man whose lack of knowledge of current science prevents him from doing anything except rule-of-thumb work cannot be considered a practical engineer because his practice is almost sure to be faulty unless it is confined within the narrowest of limits; and when within those limits, discoveries may at any time be made which will render that practice obsolete. He may be a mechanic or craftsman, but he is not an engineer.

The engineer then must be qualified to apply through the craftsman, the mechanic, and the labourer, the known laws of nature as applicable to his particular branch of engineering and as further disclosed to him from time to time by the man of science and research.

Would even this be sufficient to qualify a man as a practical engineer? Not unless his engineering plans and designs take full account in each case of the limiting commercial conditions, and not unless his practice is found by comparison to be efficient and economical. It is because men claiming to be engineers have been so often found to be inefficient and uneconomical in their practice that business men are inclined to discriminate in favour of so-called practical engineers, and against so-called theoretical engineers. In such cases we find the term theoretical engineer used by way of reproach, because the one using it fails to recognise that work which is to be done in advance of an established practice must be based upon theory, and fails to see that a man should not be reproached for following a theory—but he should be so reproached only when he acts upon a partial or incorrect theory.

And here is where the practical ability of the engineer first is employed; namely, in the fitting of a correct and complete theory to the work in hand. In each case theory and practice must be adjusted with regard to each other. To-day the engineer must aim at a high degree of efficiency; he must not employ his power wastefully. He must go further; he must develop the maximum of efficiency from the minimum expenditure of capital, all things considered.

Then to be efficient—that is, to be practical—in the management of important engineering work, the engineer must be qualified by training and experience to conduct his work in conformity with commercial conditions, limitations, and methods. Unless he knows, understands, takes advantage of, and guides himself by, the established usages of the business world he must of necessity waste energy, time and money, and so suffer from the competition of those who are better equipped.

I hope you men will be inclined to criticise me for taking so much time to establish this point, for the reason that you have no desire to disagree with me; but from my past experience with engineering students, I can hardly hope that you are all yet prepared to believe that the engineer needs to be trained in business conditions and methods.

In this connection, let me quote one paragraph from a recent lecture by Mr. W. M. McFarland before Sibley College:—

"The machinery for waterworks pumping engines offers a field for consideration of the commercial aspect. If the pumps are located in a district where coal is very cheap, it is easy to see that elaborate refinements to secure great steam economy may represent a financial loss, while, on the contrary, where coal is high, it pays to get the most economical machinery. In other words, the engineer when scheming his general plan of machinery, ought to make up comparative statements which would include not only the cost of fuel, but the interest on the first cost and allowance for depreciation, repairs, &c. The machinery which represents the lowest aggregate of these annual costs will be that which is best to use."

All this is self-evident as stated.

But, unfortunately, too many engineers lose sight of this truth when the necessity for its application appears, and many others who are prepared to acknowledge that such commercial limitations and conditions should be carefully considered, find themselves, by reason of inexperience in the matter of business methods, incapable of putting into effect the truth which they accept.

I have frequently met this weakness in my young engineering assistants.

I shall now speak to you of the necessity of an engineer being qualified to take cognizance of commercial limitations and conditions through his acquaintance with business methods. . . . In nearly all engineering work, and especially in the operation of industrial works, it is necessary to meet intelligent competition. This means that we must be constantly on the lookout for improved and more economical methods of production. If there is a chance for improvement we must discover it and avail ourselves of the opportunity.

But how shall this be done if we concern ourselves only with the results as to product and cost, and we do not keep accurate, detailed record of the work step by step. We may quite readily, perhaps, be able to find the final cost of a complete piece of work—though even this is too frequently neglected—but we cannot learn the cost of each step of the work except by a system of account-keeping adapted to the particular work in hand. Unless we can by analysis of such a detailed account of cost determine with accuracy the cost of each step in the process, how shall we discover the wasteful steps; and if we do not locate them, how can we correct them?

But, you may reply, this can all be left to competent accountants. So it could be, after the competent accountants are found. Who shall say that they are competent? If you were the manager of a manufacturing establishment, would you be prepared to take an accountant on faith? The other employés you would expect to select through the exercise of your trained judgement. The managing engineer does not need to be an expert book-keeper, but he does need to have a knowledge of the principles of accounting. He should be able to direct, or, at least, intelligently criticise, the accounting methods followed in the keeping of his concern's records. This is a matter of vital and final importance.

* Abstract of an Address delivered before Sibley College, Cornell University, and printed in full in the *Sibley Journal* for May, 1904.—From the *Electric Club Journal*, July, 1904.

In connection with shop cost-keeping and the determining of the makeup of that important account sometimes called profit and loss and sometimes loss and gain, one very important feature enters in with nearly every business, namely, that of depreciation.

Many a concern has gone along serenely paying out dividends in ignorance of the fact that they were not earned; the fact being that these dividends were paid from capital because depreciation had not first been covered from the earnings.

Many a concern which shows a profit for a given period would show a loss if the statement of assets and liabilities were corrected to show the reduced value of the plant, accounts receivable, bills receivable, goods in store, partly manufactured goods and raw material.

Again you say, this is all business judgement and common sense and does not require a knowledge of accounting to enable one to exercise a wise control. But bear in mind that the record of all facts will appear in books which are kept by methods unfamiliar to you, and you cannot, therefore, consider them first hand. I am only arguing in favour of the engineer having such a knowledge of accounting that he can intelligently consider an accountant's statement.

Let me say I am not expressing opinions; I am speaking from a wide experience in the management of industrial properties and in the conduct of a large business in constructing and consulting engineering. Many a time I have reluctantly been obliged to decide not to promote some junior engineer because he could not, or would not, see that the engineer must also be competent as the man of business unless he is satisfied to remain in a subordinate position. Of two men considered, I have frequently passed over the man who was the stronger as an abstract engineer, because the other man had the horse sense and business ability to apply his science to the best advantage in meeting the conditions from time to time developed. Where I have used the term abstract engineer, the custom generally is to say theoretical engineer, but I hold that, just as soon as a concrete example comes up for consideration, the practical engineer must be able to establish the correct theory for the particular case, and in this sense we cannot distinguish between the theoretical and practical. As I have before said, the efficient engineer must be practical and theoretical.

I could, if I had time, give you case after case from my own experience, where, in the examination of large properties in connection with proposed change of ownership, the combined training in engineering and accounting has been required to prepare a correct statement of values within the time allowed.

I could give you example after example out of my experience in the management of a parent company to show that only by a combined training in engineering and business methods could the system of united and uniform management have been developed and maintained.

There is another feature in connection with accounting which should be referred to. The manager must develop the ability to intelligently analyse data as furnished from the records and books of account. This, by the way, is an excellent training in connection with the consideration of the strictly technical side of his work.

Another line along which the engineer should acquire some experience is in that of commercial law, especially in connection with the making of specifications and contracts. Engineers would not furnish much business for the lawyers if their specifications, contracts and correspondence were first carefully considered and then made to express just what was intended.

And this brings us to another important feature in an engineer's mental equipment: a good working knowledge of his mother tongue. He should be able to express himself clearly, correctly, explicitly, and forcibly. If he can acquire some measure of elegance, so much the better, but first let him be sure that he is expressing without ambiguity what he has in mind. There will be an additional advantage in steady effort in this direction, for he will probably discover, while there is yet time to correct the fault, that his subjects are not yet as clear in his own mind as he had supposed.

I wish I had time to give you some of the results obtained by analysing a year's correspondence of a large parent company to determine how much of the letter writing was necessitated by the original or initiative communications having been ambiguous or incorrect. Let me say that the correspondence would have been reduced to less than one-fourth of its actual volume if all communications had been made correct and explicit in the first instance. The tabular exhibit of the facts placed before those concerned materially helped to correct the evil.

A few weeks ago I was presiding at a conference of engineers in which the subject of consideration was the development of a special course of instruction to meet the needs of a certain business. Every man in the room stated that in his opinion the teaching of English was of more consequence than the teaching of any other subject. Each man had come to the conference with the intention of expressing this opinion expecting to have all the others disagree with him. As one man put it: "I prefer to have my assistants know little and be able to clearly show how little they know than to leave me in doubt as to what they do know and what they do not know."

It certainly will be conceded that the making of correct estimates of cost is well within what should be expected of the engineer.

The man who after his work is completed studies the book records of cost and compares the actual cost, item by item, with the estimated cost, is training himself in the best possible way to make correct estimates in the future. And it is very seldom that the man who does not understand business methods can prepare reliable estimates of cost. It is for this reason that, when engineers present their estimates for the performance of some large work, we so often hear the hard-headed men of business suggest that as it is an engineer's estimate, 50 per cent. or 100 per cent. should be added. And too often the engineers by their woeful lack of business ability have furnished sufficient reason for these criticisms.

There is another practical advantage to be obtained from the detailed comparisons of estimates with cost sheets. The engineer who so compares his estimates with his results is training himself to follow the most economical methods in future.

In my business experience I had found that the young engineers who came to me for employment were not only deficient in knowledge of business methods, but they often found it difficult to believe that the engineer should have such knowledge, and some were unwilling to so believe even under pressure. Not a few were convinced only when they found themselves outstripped by their fellows of more open mind.

When I began my work at Stevens I found that the first and most important step was to convince the students of my classes that this subject is one which the engineer cannot afford to neglect. I feel that if I succeed in convincing my students on this point during their senior year and nothing more, I have saved many of them from serious and perhaps irrevocable loss in connection with their post-graduate training in the field of practice.

I include in my course, accounting, depreciation of plant, shop cost, analysis of data and statistics, and commercial law, especially as bearing upon contracts. In connection with work along these lines, I weave in, as far as possible, hints as to business methods in general, and in particular I try to show the great desirability of an engineer making his communications, specifications, &c., self-explanatory and free from ambiguity.

I feel that if these men can be convinced of the real value of study in this direction they can, with their well-disciplined minds, quickly make good their deficiencies in connection with their daily experiences. But if they obstinately and stupidly refuse to see the necessity for this knowledge, they, of course, will remain in their ignorance and so be forced to remain in subordinate positions as employés of men of broader mind. There are exceptions, but it is hardly safe for any man to calculate upon his being able by reason of exceptional ability to rise superior to rule.

I venture to prophesy that 95 per cent. of the engineer students who are now listening to me will within five years of their graduation, if not before, agree to my proposition.

I further prophesy that most of those included in the remainder—if there be any remainder—will by that time have demonstrated that their opinions are not of much worth beyond some very narrow limits.

If I were asked to express an opinion as to where there was the best opportunity to improve our courses in engineering, I would not speak of the necessity for better equipment to illustrate the specialties in engineering so rapidly and so forcibly coming forward for recognition, but I would say that the improvement might first better be looked for in three directions:—

1. Greater thoroughness in the fundamentals of mathematics and science.
2. A greater amount of practical instruction in English.
3. Instruction in the commercial side of engineering and in business methods, particularly as bearing upon engineering practice.

Part of this, I have no doubt, sounds very sordid to some of my hearers. But I venture to hold the opinion that instruction in the business side of engineering offers the best possible opportunity for training engineer students in the ethics of their profession.

I say this though I am fairly familiar with the arguments against the introduction of commercialism into the curricula of our institutions of higher learning.

I contend that the first point to be aimed at in education is to equip the students to be self-supporting and so self-respecting.

I contend that, in adding instruction in business methods to the engineer-students' curriculum, we are also increasing the chances of developing our students as all-round men.

It is a decided step in the direction of true culture if we can lead our disciples to look at things from all points of view, and especially from that of the other man.

It is right, then, that we should point out to the engineer-student how he can best do his whole duty to his employer and to the community.

From my experience as an engineer, business manager and educator, I am firmly of the opinion that such a course of instruction in business methods as I have outlined increases the technical and practical efficiency of the course, and it greatly increases the opportunities for the students to gain in culture.

THE "ACME" INTEGRATING WATTMETER FOR CONTINUOUS CURRENT.

In this meter the whole of the mechanism is mounted on a zinc base, and is thoroughly protected against both dust and possible damage by means of an hermetically fitting cover of insulating material.

The meter works on the motor principle; the lower end of the armature spindle runs in a jewel, whereas the upper end is guided by a springy brass bearing.

The armature (6) (fig. 3) is mounted on the armature spindle (3), and is magnetised by a stationary pressure coil (9), while it is driven by the main current coils (10 and 11), which are also stationary. The pole-piece (7) revolves outside, whilst the pole-piece (8) revolves

inside the field coils (10 and 11). Both pole-pieces are situated on the same side of the armature spindle (3), and the poles are as close as possible to one another. It follows that the armature is practically immune from external magnetic influence, and, therefore, cannot be maliciously tampered with.

Fig. 1.—The "Acme" Meter; Outside View.

During each revolution of the armature, the direction of the current in the armature coil is reversed only twice. This is not effected in the customary manner by means of a commutator fixed to the spindle and brushes, but by means of a specially constructed commutator. This novel device consists of a laminated commutator (1) which rests in two special bearings, and is quite independent of the armature spindle. Both the commutator brushes (2) are connected with the stationary armature winding, whilst the current is led to the segments through two small contact blades (4) and (5), which bear on the pivots of the commutator (1).

Connected to these is a disk (12) carrying round its periphery a number of pins corresponding to the number of segments on the commutator.

After a semi-revolution of the armature (6), one of the two semi-circular disks (13) and (14) engages one of the aforementioned pins, rotating the commutator (1) through the width of one segment, whereby the current in the armature coil is reversed.

Since the reversal takes place at the dead point of the armature, its own momentum would not suffice for the operation of the commutator (1), and consequently a small contact device (15) is fixed on the upper pivot of the armature spindle (3). By means of this

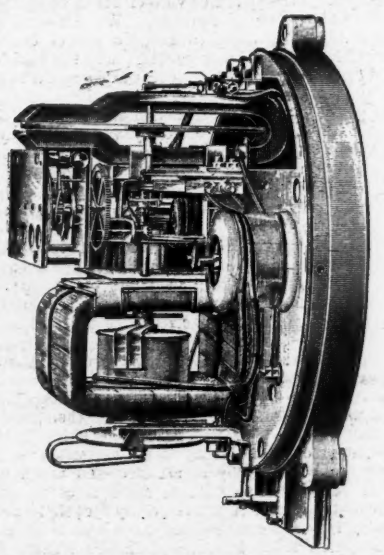


Fig. 2.—The "Acme" Meter; Cover Removed.

a small electro-magnet (16) is connected in parallel with the armature winding (9) and a portion of the resistance in circuit with the latter, when the armature (6) reaches the reversing point. Two objects are attained by this means:—

1. The armature obtains additional motion through the auxiliary armature (17), which is attracted by the electric magnet (16) at this moment, completely overcoming the dead point, and ensuring the proper action of the commutator, as well as compensating for bearing friction for the half revolution.

2. In addition, owing to the aforementioned coupling in parallel of the magnet coil (16) with the armature winding (9), the latter is at the moment of reversal carrying practically no current, so that the reversal takes place without any sparking whatever.

This additional impulse comes into operation during about one-sixteenth of each revolution. It follows, therefore, that the variations of friction on the commutator, however perfectly provided for in other meters, can have only one-eighth the influence in this meter, as compared with meters with rotating armatures of the ordinary type. Moreover, any variations whatever in the contact friction of the brushes are absolutely excluded in this meter, because in consequence of the aforementioned parallel coupling of magnet and armature coil, all risk of sparking at the moment of reversal is abolished. It follows from this arrangement that no constant driving torque to compensate for friction is required in this meter, so that running on "no load" is absolutely done away with. Again, the starting of the meter is materially improved compared with that of ordinary commutator meters, because the armature runs absolutely free during the greater portion of its revolution, and at those points where the commutator friction comes into operation, the armature receives an auxiliary impetus of such magnitude as to complete the revolution entirely without current.

The recording mechanism is driven by a worm fixed on the commutator shaft. Any adverse influence that the recording train might have on the working of the mechanism of the meter is excluded, seeing that the motion is derived from the commutator spindle, and not from the armature spindle.

The weight of the complete apparatus is only 9 lbs.; it consumes only about 1·8 watts on a 100-volt circuit, and starts with a load of 1 per cent. of the full load. The weight of the moving parts resting

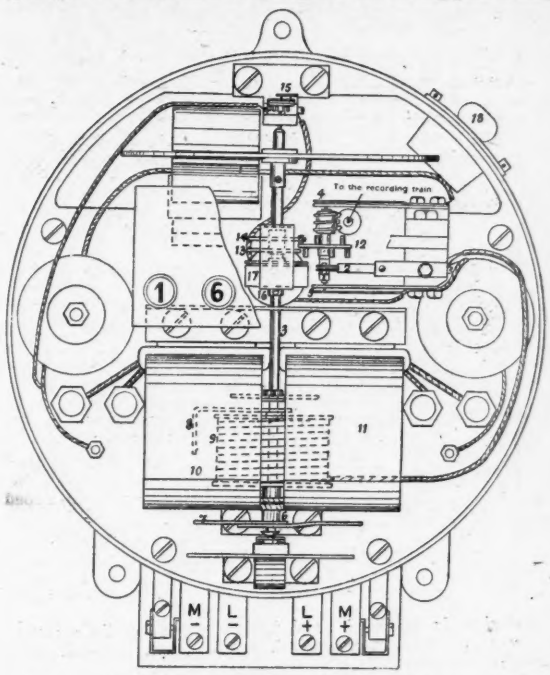


Fig. 3.—Diagram of Meter Parts.

on the jewel is extremely small—namely, 75 gm.—so that the wear and tear and the risk of fracture of the jewel are reduced to a minimum, and the bearing friction is also very small. The absence of mercury and of complicated clockwork from the mechanism is claimed as an important advantage, while the large armature torque and the silent running of the meter are additional recommendations.

The "Acme" meter (type E) is being placed on the British market by Messrs. A. & E. Cohen, of 2, Bury Street, St. Mary Axe, E.C., to whom all inquiries should be addressed.

THE VALUE OF EDUCATION TO AN ELECTRICAL ENGINEER.

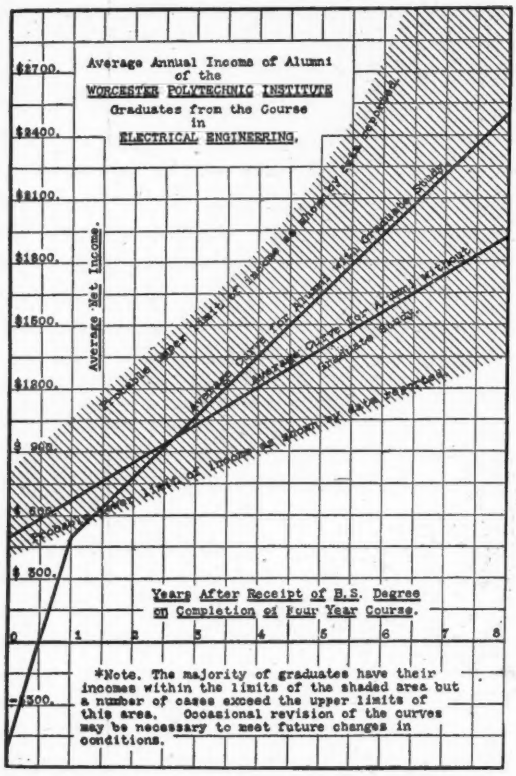
The forthcoming (November) number of the *Journal of the Worcester Polytechnic Institute* will contain an article discussing the records made by electrical engineering graduates trained at that Institute. It is remarked that the value of a thorough education fitting a young man for his life work is no longer a debatable question. The recent report of the United States Bureau of Education shows that a boy with a common school education has practically one chance in 9,000 of general recognition as a successful man in some department of human endeavour and usefulness.

A high school education increases his chances of such success by about 22 times, while a college education gives a young man about 10 times the probability of success and advancement possessed by the high school graduate, or about 200 times the opportunity open to the boy with only a common school education.

While the basis of income which a man may be able to secure is, in many respects, a false standard of comparison, yet it is, perhaps, as definite a measure of his worth as any single method at our command. For this reason, the following data presented by Mr. Dodge in his recent Presidential Address before the American Society of Mechanical Engineers is of much interest. From carefully prepared averages, he found that in engineering work the average unskilled man at 22 years of age has reached his maximum earning capacity of $510.00 per year, which, capitalised at 5 per cent., gives

him a potential value of about $10,000,000. The shop-trained man reaches his maximum of $790.00 per year at 24 years of age, while the curve of income for the technical school graduate of 10 years' standing is still rising at 32 years of age, when he receives an annual income of $2,150.00, which gives him a potential value of $43,000.00 when capitalised at 5 per cent.

Although this result, as shown by Mr. Dodge, has been criticised as being more favourable to the technical graduate than is justified in the average case, the accompanying diagram, which has recently been prepared from data received from graduates of the Worcester Polytechnic Institute in Electrical Engineering, substantiates the


Average Annual Income of Alumni of the WORCESTER POLYTECHNIC INSTITUTE Graduates from the Course in ELECTRICAL ENGINEERING.
$2700.
$2400.
$2100.
$1800.
$1500.
$1200.
$ 900.
$ 600.
$ 300.
Average Net Income.
Years After Receipt of B.S. Degree on Completion of Four Year Course.
0 1 2 3 4 5 6 7 8
$1500.
*Note. The majority of graduates have their incomes within the limits of the shaded area but a number of cases exceed the upper limits of this area. Occasional revision of the curves may be necessary to meet future changes in conditions.

conclusions drawn by him, and further emphasises the value of a thorough technical training, such as that given by the Worcester Polytechnic Institute.

This diagram shows most completely the financial prospects of technical graduates from year to year. As the Department of Electrical Engineering at the Worcester Polytechnic Institute has been established but eight years, there are data available for this period only, but during this time a large number of students have graduated, and data have been received from a sufficient number of them to represent conditions fairly. From these curves, it is seen that the average graduate who receives $500.00 per year for his first position after leaving the Institute, rapidly increases in value, so that, at the end of eight years, he may expect to receive an income of about $1,900.00; or, if he has been a graduate student at the Institute for one year, his income is shown to average about $2,500.00, which, capitalised at 5 per cent., gives him the income on an investment of about $50,000.00. By investing five years of his time and the cost of his college training, he has, after a few years, and for the remainder of his life, increased his income earning value by not less than $40,000.00.

HOW MESSAGE WIRES ARE GUARDED ON THE CONTINENT.

That looks rather "Answerish," but it is to serve as the title of a review of Continental methods of protecting falling telegraph and telephone wires from contact with trolley wires, gathered from the excellent report by M. Petit, "Ingénieur chef de division de la Société Nationale des Chemins de fer Vicinaux, Bruxelles," to the thirteenth general meeting of the "Union Internationale de Tramways, &c."

In England we have ceased almost to kick actively against the system of guard wiring imposed by the B. of T. at the command of, and in the chief interest of, the P.M.G.

It is some time since we had an article on the subject, but this report will re-awaken public interest.

M. Petit obtained information from 60 tramways, and the questions to which answers were sought were, roughly, as follows:—

1. What system do you use?
2. Have you used any other? If so, why did you discard it?
3. Did the authorities make you guard?
4. How does the system employed work?
5. What is the cost of maintenance?
6. Have you had to subscribe to any part of the cost of altering telegraph or telephone circuits?
8. What form of trolley do you use: the wheel or the bow?

It is noticeable that Glasgow is the only English (*sic*) town whose opinions were obtained. Whether other towns were asked is not disclosed.

Unfortunately no very definite conclusions as to the comparative safety and general excellence of any system can be drawn from the replies, which are tabulated at the end of the report. Practically the only systems mentioned are guard-wires, disposed variously, and the wooden strip with which we used to be familiar.

We were surprised somewhat to find that the latter device has so many adherents—is, in fact, in the majority of 29 to 20 so far as the report goes, while of the other 11 tramways nine combine wire and wood, and two only are in the enviable position of having to protect no wires, as these have been put underground, the best place for them from every point of view.

We had supposed that the system of guarding adopted in any particular case would have some relation to the form of trolley in use—that is to say, wherever the bow trolley is used, guard wires would be almost innocuous, while inclination would prompt the use of the wood strips with the trolley wheel; but there is actually no connection at all, so far as we can judge from the table. The wheel is used by 46 tramways against 13 for the bow.

The second question produced some replies which show clearly that the authorities of the various governments are by no means unanimous as to which is the better method of the two. For example, Aix-la-Chapelle, Bremen, Dresden, Konigsberg and Linz began with wires, and were forced to change to wood strips (réglettes), while Barmen and Erfurt started with wood, and had to put up wires.

The answers to the fourth question are interesting, though somewhat contradictory; 20 undertakings are satisfied that the guard-wires fulfil their purpose, but six are not so pleased; 23 undertakings are satisfied with wood, and four are dissatisfied, while out of the tramways which are using both kinds of protection, three prefer the wires, and three prefer the wood. On both sides complaints of the frequency of repairs are heard, and some consider the wires dangerous.

M. Petit himself is in favour of the wood strip, so far as he favours any system of guarding, but we cannot agree that the evidence before him was overwhelming in that direction. Personally, we feel that, while a properly installed system of wires may protect fallen message wires more effectually than wooden strips can do, the latter is to be preferred on account of greater public safety, simply because there are then no guard-wires to be pulled down by errant trolleys.

At the same time we do not desire anyone to think that we like the wood strip from the points of view either of adequate protective capabilities, or of economical working. We are sure, indeed, that it is a most troublesome thing to keep in proper order, and it is only too possible that a fallen wire will touch the bare trolley wire and cause the accident which the wood was designed to prevent.

M. Petit points out that there is no regularity about the method of applying guard-wires. Some are content with one wire parallel to and immediately above the trolley wire, others will have a regular network over the trolley wires; some again still stick to insulated wires, although the majority conform to common sense notions on that point, and while some use copper or bronze wires (not necessarily because of peculiar atmospheric conditions), others use the ordinary steel wire.

M. Petit sums up against the guard-wire, as we have often done:—"The guard wires constitute a greater danger than that which it is sought to prevent;" and he lays stress on the probable rapid deterioration of the trolley wire at places where trolley poles become de-wired and cause short-circuits between guard and trolley wires, ending finally in the latter breaking.

The reporter believes after all, that short of entire removal of aerial message wires, the best solution is to persuade the owners of those wires to bunch them where they cross the tramlines, and to allow cradles formed of wires to be strung under them, but he regrets that the various interests are so often in opposition (generally without just cause, to our mind) that it is impossible to frame rules which shall apply absolutely in all cases and under every condition. Those remarks apply with as much force to us as to any European country, and it is a melancholy fact that our regulations for the protection of message wires have been framed, as we indicated before, more in the interests of the Post Office than of the public at large.

Probably the most interesting portion of the report is that dealing with the sixth question. From the table it appears that a large number of the tramways have had to pay heavily for alleged interference with the message wires along their routes. Aix-la-Chapelle paid 25,000 marks for moving and doubling these wires and for protecting them with fuses. Charleroi paid no less than 70,000 fr. for similar privileges, and altogether (not counting the few who replied indefinitely or not at all) 13 have had to double the message circuits, eight to remove them to other positions, and twenty to protect them with fuses, in addition to the guard wire or guard strip over the trolley-wires. That a somewhat similar state of things has troubled tramway undertakers in England should not make us indifferent to the woes of others, but sympathetic with them, and we say with M. Petit:—"Why should the State reserve to itself the sole right of user of public roads for the installation of its wires, and impose often onerous conditions on tramway companies for permission to enter the zone which it has occupied first." He says later that the State should recognise that while it has a universal duty to perform in maintaining the telegraph and tele-

phone services in the highest state of safety and order, yet it has also a great public duty to perform in not putting obstacles in the way of the natural development of tramways.

Fortunately justice is not dead, and instances are quoted in which the worm has turned with notable effect. The Hamburg Tramways Co. have obtained a judgment from the High Court, that they are not bound to contribute to the cost of equipping message-wires with fuses. Cologne Municipality and the Helsingfors Tramways have actions pending against the Post Office for the recovery of similar expenses. In the same interesting way, after fighting through four courts, the town of Mannheim has forced the Post Office to refund the sum of 30,000 marks, on the ground that the danger against which it had to guard would not have existed unless the Post Office wires were above the trolley-wires.

Of course, the only solution of the difficulty is to place the aerial wires underground. Amsterdam has done this among large towns, and Vienna is about to follow suit. Year by year we hear more of the same solution in England, and it behoves the promoters of new undertakings or extensions to do their utmost to come to an amicable arrangement with the Post Office and the National Telephone Co., either to cable parallel wires and to cross at convenient intervals, or to bury the wires out of the way, lest they have to say, with unfortunate Helsingfors, that the cost of maintaining guard-wires is 20 per cent. of the expenses of the line, and that they cause frequent interruptions to the service.

The report contains an appendix summarising the regulations imposed by 15 European countries.

Altogether it is a valuable compilation.

THE NEW BOARD OF TRADE REGULATIONS.

(*Concluded from page* 400.)

WE next come to the consideration of overhead lines, called in the old rules "aerial lines." These clauses apply, of course, only to undertakings in the provinces. Clauses 14 and 15 of the provincial prints (*i.e.*, Nos. 1 and 2) remain as old Clauses 17 and 18, but the requirement that metal supports shall be connected with earth disappears. In Clause 16 (old Clause 18) the rule regarding the attaching of insulated conductors by metal binders is also omitted; no doubt this is considered unnecessary under the present conditions. Old Clause 19 has been completely altered by Clause 17, the minimum height of wires being increased from 18 ft. to 22 ft. It will bear quoting:—

An overhead line placed after the date of these regulations shall not in any part thereof be at a less height from the ground than 22 ft., or accessible to any person without the use of a ladder or other special appliance. A high-pressure overhead line placed after the date of these regulations shall not in any part thereof be at a less height from the ground than 28 ft. where it crosses a street.

Clauses 18 and 19 are also new, and are of considerable interest in view of modern practice:—

18. Where a supply is given by overhead wires on the three-wire system, the positive and negative conductors shall be placed above the intermediate conductor. The intermediate conductor shall consist of two wires placed at a greater distance apart than the positive and negative conductors, and these two wires shall be connected by cross wires, two for each span, fixed at a distance not less than 6 ft. from the insulators.

19. Where a supply is given by overhead wires from a traction system, the positive conductor shall be placed above the negative conductor in such a manner that, in the event of breakage, it must fall on the negative conductor.

Clause 20, dealing with service lines, is similar to old Clause 20, except that portions of service line outside but within 7 ft. of a building, need not be enclosed in stout india-rubber tubing, but shall be efficiently protected by insulating material. Clauses 21 and 22 remain as before, as do also 23, 24, and 25, corresponding to old Clauses 24, 25, and 26, and dealing with discharge of pressure in case of fire, maintenance, and disused lines. Old Clause 23 referring to suspending wires of course disappears.

Coming now to electric lines other than overhead lines, we find old Clauses 27, 28, and 29 practically maintained, but Clause 30, dealing with short lengths of pipe, is omitted as being covered by the previous conditions. Clauses 32 and 33, referring to high pressure lines laid above-ground or in proximity to other electric lines, or to the surface of the ground, remain intact, but the safety of high pressure lines is ensured by the following new Clauses 32 and 20, provincial and London regulations respectively:—

32. A high pressure electric line shall not be brought into use for the supply of energy before it has been completely laid, properly jointed, examined, and tested, or while it is still in charge of other parties than the undertakers.

Old Clause 34 relating to street boxes remains as before with respect to sub-clauses (*a*) to (*d*), but the following new sub-clauses are added:—

(*e*) Where high-pressure and low-pressure mains pass through the same street box, they shall be readily distinguishable from each other.

(*f*) The maximum power supplied to any transformer placed singly in a street box shall not exceed 30 KW. without the consent of the Board of Trade.

Transforming stations are now called sub-stations, and whilst old Clause 35 stands, a new one of some interest to undertakers is added:—

Sub-stations shall be erected above-ground wherever possible, but where necessarily underground, they shall be constructed in accordance with plans approved by the Board of Trade, and the maximum power supplied to any underground sub-station shall not exceed 75 KW. without the consent of the Board of Trade.

The next part deals with consumers' premises, and here the Clauses relating to responsibility of undertakers, and to fire risks, remain as before, but the following important addition is made by Clauses 38 and 26 respectively:—

Where a supply is given to a building for public purposes, the undertakers shall periodically satisfy themselves that the wires and fittings within the building are maintained in a safe condition.

Clause 38, relating to main fuses, also stands, but it is further provided that "no fuse or automatic circuit-breaker may be inserted in the intermediate conductor of a three-wire system."

Old Clauses 39 and 40, relating to treatment of electric lines, &c., on consumers' premises, and transformers to be enclosed in metal, stand; but Clauses 42 (Provinces) and 30 (London) respectively, are new, and run:—

Transformers and all high pressure apparatus used for the supply of energy to a consumer's premises, unless the premises are a factory, mine, or electric traction works, shall be the property of, and under the charge of, the undertakers.

The remaining clauses relating to consumers' premises have not been changed.

The clauses dealing with arc lamps, so far as guarding and height from ground are concerned, remain as before, but old Clause 46 (cut-off switch) is dropped. The following new Clause 48 (Provincial) and 36 (London) has been added, and is likely to be of importance in the future.

Connection of Circuits with Earth.

Where the pressure of a supply between the adjacent conductors of a three-wire system of mains exceeds 125 volts, the intermediate conductor must be connected with earth, with the concurrence of the Postmaster-General, and in accordance with the following conditions:—

(*a*) The connection with earth of the intermediate conductor must be made at one point only on each distinct circuit, namely, at the generating station, sub-station, or transformer, and the insulation of the circuit must be efficiently maintained at all other parts.

(*b*) The system of distributing mains must be separated into sections corresponding approximately to the different feeders, and these sections may be interconnected only through suitable circuit-breakers or fuses, arranged so as to be easily inspected.

(*c*) The current from the intermediate conductor to earth must be continuously recorded, and if it at any time exceed one-thousandth part of the maximum supply current, steps must be immediately taken to improve the insulation of the system.

The penalties for default relating to the whole of Section A are as before.

We next come to Sec. B., regulations for ensuring a proper and sufficient supply of electrical energy. Clause 1 (notice of intention) has not been changed, and Clause 2 (constant supply) remains practically as before, but that in the case of continuous currents, change of polarity is not allowed except so far as the Board of Trade may permit; whilst reference to the local authority is omitted. The remaining clauses are simplified and arranged somewhat differently from those in the 1896 Regulations, and we therefore quote them in full for Provincial companies.

4. Before commencing to give a supply of energy to any consumer, the undertakers shall declare to such consumer the constant pressure at which they propose to supply energy at his terminals.

The pressure so declared at any pair of a consumer's terminals shall not at any time be altered or departed from except by consent of the local authority,* and upon such terms and conditions as the local authority* may impose, and after public notice has been given during a period of one month, in such manner as the local authority* may require, of the intention of the undertakers to apply for consent to alter the same. [If the local authority* refuse to consent to an alteration or impose any terms or conditions with which the undertakers are dissatisfied, the undertakers may appeal to the Board of Trade, whose decision shall be final.]†

Provided that the undertakers shall be deemed to have complied with the requirements of this regulation so long as (except with the consent of the Board of Trade) the variation of pressure at any consumer's terminal does not under any conditions of the supply which the consumer is entitled to receive exceed 4 per cent. from the declared constant pressure.

The following clause, relating to frequency, is new and necessary, whilst the proviso regarding variation should meet all the requirements of engine-makers.

5. Before commencing to give a supply of energy by alternating current to any consumer, the undertakers shall declare to such consumer the number of complete periods per second at which they propose to supply energy. The frequency so declared shall not at any time be altered or departed from except by consent of the local authority,* and upon such terms and conditions as the local authority* may impose, and after public notice has been given during a period of one month, in such manner as the local authority* may require, of the intention of the undertakers to apply for consent to alter the same. [If the local authority* refuse to consent to an alteration or impose any terms or conditions with which the undertakers are dissatisfied, the undertakers may appeal to the Board of Trade, whose decision shall be final.]†

Provided that the undertakers shall be deemed to have complied with the requirements of this regulation so long as the frequency does not vary more than 2½ per cent. from the declared frequency.

The penalty clause remains exactly as before.

The foregoing analysis will give those conversant with the old regulations an insight into the changes effected. Speaking generally, these tend to remove, rather than to impose, restrictions, and any action in this direction should be gratefully received, with the hope that as the public becomes more accustomed to electrical supply, further restrictions which may now appear necessary, will also be removed.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

18,141. "Improvements in electric block systems for railways." F. C. ROBINSON. August 22nd. (Date applied for under Patents Act, 1901, August 22nd, 1903, being date of application in United States.) (Complete.)

18,162. "Improvement in arc lamps." J. D. F. ANDREWS. August 22nd.

18,163. "Improvements in arc lamps." J. D. F. ANDREWS. August 22nd.

18,173. "Improvements in vapour electric apparatus. E. A. CAROLAN. (The General Electric Co., United States.) August 22nd.

18,181. "Improvements in telegraph transmitters." W. J. ROUSSEL and A. KING. August 22nd. (Complete.)

18,185. "Improvements in means for controlling electric power distributing systems." J. L. ROUTIN. August 22nd. (Complete.)

18,199. "Improvements in and relating to controllers for electric circuits." C. C. GARRARD. August 22nd.

18,201. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 22nd.

18,202. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 22nd.

18,203. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 22nd.

18,204. Improvements in transformers especially adapted for use on electric vehicles." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) August 22nd.

18,208. "Improvements for effecting telephonic intercommunication." J. YOUNG. August 23rd.

18,225. "Improvements in electrical switches." J. PESCHEK. August 23rd.

18,252. "Improvements in automatic electric telegraphic transmitters." O. HENN. August 23rd. (Complete.)

18,255. "Improvements relating to the parallel running of dynamo machines." The Hon. C. A. PARSONS and G. G. STONEY. August 23rd.

18,280. "Improvements in magneto-electric machines." F. R. SIMMS. August 23rd.

18,299. "Improvements in controllers for electrically operated capstans and the like." W. H. SCOTT. August 23rd.

18,306. "Improvements in apparatus for electric advertising." J. COLSHAW. August 24th.

18,316. "Improvements in electrical measuring instruments." K. EDGCUMBE and E. I. EVERETT. August 24th.

18,317. "Improvements in electrical switches." J. A. K. MCGREGOR and H. WREN. August 24th.

18,322. "A system of electric lighting for railway trains." H. PIEPER and G. L'HOEST. August 24th. (Complete.)

18,342. "Improvements in electric incandescent lamps." J. W. PHELPS. August 24th. (Complete.)

18,343. "Improvements in electric incandescent lamps, connections, and switch mechanism therefor." W. J. PHELPS. August 24th. (Complete.)

18,356. "Improvements in electrolysers." F. L. BARTELT. August 24th.

18,358. "Improvements in electric measuring instruments." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 24th.

18,359. "Improvements in incandescent electric lamp sockets." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 24th.

18,361. "Improvements in resistances for electrical apparatus." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 24th.

18,369. "Improvements in trolleys for electric cars." G. B. ROBSON. August 24th.

18,378. "Improvements in, and relating to, combined electric switches and fuses." B. S. HORNBY. August 24th.

18,383. "An improved indicating device for electrical fire alarms." R. HOENICKE. August 24th. (Complete.)

18,408. "An improved electrolytic process and apparatus therefor." C. P. TOWNSEND. August 25th. (Complete.)

18,429. "Improvements in selective telephone call mechanism." H. I. HAWXHURST. August 25th. (Complete.)

18,439. "Improvements relating to the charging of accumulators or secondary batteries." R. S. MCLAREN. August 25th.

18,446. "Improvements in vapour electric apparatus." E. A. CAROLAN. (The General Electric Co., United States.) August 25th.

18,447. "Improvements in, or relating to, vapour electric lamps." E. A. CAROLAN. (The General Electric Co., United States.) August 25th.

18,448. "Improvements in vapour electric apparatus." E. A. CAROLAN. (The General Electric Co., United States.) August 25th.

18,464. "An improvement in electric trolley heads, with wire-finding apparatus attached." J. T. CHERRY and E. H. CLIVE. August 26th.

18,469. "Improvements in trolleys for electric tramways and railways." J. E. BENTLEY. August 26th.

18,496. "An improved switch for electric circuits." J. G. FARQUHAR. August 26th.

18,499. "Improved system of cable connections with electrified railways." J. S. WOOD, W. S. WOOD and J. R. WOOD. August 26th.

18,501. "Improvements in primary batteries." G. WALLACE and W. J. L. SANDY. August 26th.

18,520. "Improvements connected with coin-freed gas, electric, or other meters." F. J. BEAUMONT. August 26th.

18,546. "Improvements in electric incandescent lamps, whereby two or more lamps are governed by one central connecting cap, or the like." M. BYNG and W. J. CRAWSHAW. August 27th.

18,561. "Improvements in live rail protections for electric railways." J. LINKLETER. August 27th.

18,592. "Improvements in electric railways." E. A. CAROLAN. (The General Electric Co., United States.) August 27th.

18,594. "Improvements in galvanic batteries." L. FIEDLER and F. J. GERARD. August 27th.

18,615. "Improvements in interrupters for ignition coils of internal combustion engines." J. CARPENTIER. August 27th.

* Provincial local authorities are responsible to the Board of Trade, and London undertakers of both classes to the London County Council.

† This part is, of course, omitted for Provincial local authorities.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

ELECTRICAL SWITCHES. G. Sperryn and W. H. Wood. 4,451. February 23rd.

METALLIC CIRCUIT INTER-COMMUNICATION TELEPHONES. M. W. F. Petmeky. 4,646. February 25th.

ELECTRIC IGNITION APPARATUS FOR INTERNAL COMBUSTION ENGINES. S. Brotherhood and C. W. Bryant. 4,891. February 27th.

APPARATUS FOR REGULATING AND CONTROLLING THE VOLTAGE OF ALTERNATING CURRENT CIRCUITS. H. R. Stuart. 5,071. March 1st. (Date applied for under International Convention, March 12th, 1903.

COILS FOR ELECTRICAL MACHINES. I. de Kaiser. 5,560. March 7th. (Date applied for under Patents Act, 1901, May 1st, 1903, being date of application in United States.)

Electrolytic Production of Pure Compact Tin.—A German patent has been taken out by Dr. H. Mennicke, of Hattersheim, for an electrolytic method of obtaining chemically pure and crystalline compact tin from any substance containing that metal, the other metals simultaneously present being precipitated. The electrolyte employed is a solution of tin chloride, to which is added rather more ammonium chloride than is necessary to yield the double salt $SnCl_4.2NH_4Cl$, the alkali salt having the property of increasing the conductivity of the liquid, and of assisting in the dissolution of the tin from the anode. This, or another, ammonium salt has also the effect of encouraging the deposition of the tin in a silver-white crystalline condition. The ammonia set free by the action of the current is held by an organic acid, which is decomposed at the same time, while carbon dioxide is liberated. Other organic acids capable of dissolving the foreign metals result from the action, or such bodies must be added to the bath. For instance, lead acetate may be produced, and, in presence of air and other influences (especially if the liquid is warm) is converted by the current into basic acetate. The carbon dioxide then reacts with the lead salts to form an insoluble normal or basic carbonate. In this case, however, the temperature of the electrolyte must be at least 50° C. Suitable organic acids are lactic, succinic, oxalic, malic, and hydroxybutyric acids. The electrolyte regenerates itself during the action, or may be worked up by simple evaporation with tin salts, &c. In order completely to separate part of the foreign metals which remain suspended in the liquid as insoluble compounds, the electrolyte is caused to flow against a suitable partition, when they collect on the diaphragm, and sink down to join the rest of the anode slime.